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ACACIA LEUCOPHLOEA WILLD AND *ACACIA ALBA* WILLD—TWO SPECIES OR ONE?

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Two species of *Acacia* with white bark are found in India. One with erect branches and panicles, tomentose inflorescence, flower heads of 6 mm. and tomentose legumes is distributed throughout India except the Telugu districts of the Madras Province and is known as *velvelam* (Tamil). The other with suberect branches, diffuse and pubescent inflorescence, flower heads 4 mm. and glabrous legumes is found only in the Telugu districts and is known as *tella tooma* (Telugu). Willdenow (1805) created *Acacia leucophlœa* and cites *Mimosa leucophlœa* Roxb. as a synonym. Roxburgh (1832) describes *Mimosa leucophlœa* as having suberect or spreading branches, suberect racemes, downy peduncles and pedicels and smooth legumes. Willdenow (1805) describes *Acacia leucophlœa* as having the leaflets subciliate, petiole, downy, legume flat, linear and subarcuate. If the legume in this species had been persistently tomentose as in *velvelam* he would not have ignored this very important character, especially when he describes the petiole as pubescent. The tomentose nature of the pods in *velvelam* does not disappear with age. This tomentum occurs from the ovary stage onwards and persists even on legumes which have, after maturity, fallen on the ground and become partially decayed.

Willdenow describes the flower heads of *Acacia leucophlœa* to be as big as pepper grains (4 mm.) but those of *velvelam* are twice as big. Roxburgh does not make any mention of the size of the flower heads. From this it is evident that Willdenow did not depend on the

descriptions and plate of Roxburgh's *Mimosa leucophlœa* in describing his *Acacia leucophlœa*. The legumes of this *Acacia* (*Acacia leucophlœa* Willd.) are quite glabrous both in the ovary and in all stages of maturity (*See* Plate I). Sometimes the two flat sides of the legumes are shining. Besides the glabrous nature of the legumes, the plants have suberect or spreading branches, suberect panicles, downy peduncles and pedicels and flower heads as big as pepper grains (4 mm.). The Telugu name of this *Acacia* is *tella tooma*. Roxburgh also gives the same local name for his *Mimosa leucophlœa*. On the authority of Willdenow, De Candolle and Roxburgh, the form with the glabrous pod alone should be taken as the type representing the species originally described by Willdenow as *Acacia leucophlœa*. *Acacia leucophlœa* Willd. occupies about 25,000 square miles in the Telugu districts of Nellore, Cuddapah, Chittoor, Anantapur, Bellary, Kurnool, Guntur, Kistna, Godavari, etc., in the Madras Province without intermediates. It is, therefore, evident that it is this species of *Acacia* which Roxburgh called *Mimosa leucophlœa* and Willdenow *Acacia leucophlœa* (Madras Herbarium Nos. 83048 and 85666).

Brandis (1907) makes mention of a form of *Acacia leucophlœa* Willd. found in Burma with glabrous pods. According to him, Prain preferred to consider this Burman form as a distinct species—*Acacia microcephala* Graham. Jackson (1895) correctly regards this species as a synonym of *Acacia leucophlœa* Willd.

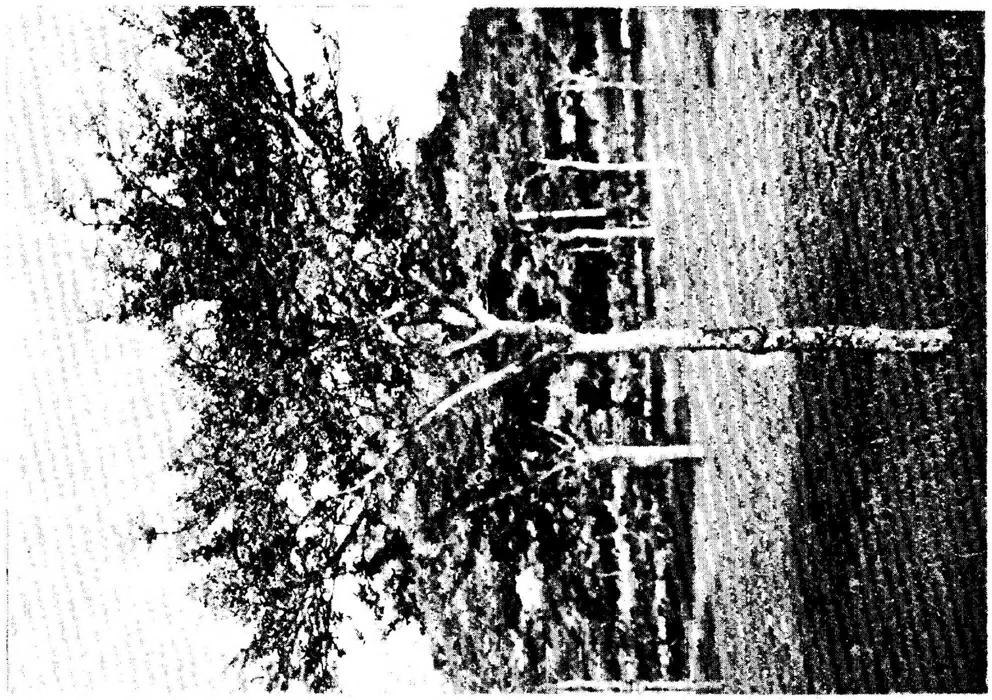
Now the question arises whether *velvelam* with the tomentose pods is a different species of *Acacia* or only a synonym of *Acacia leucophlœa* Willd. Except where *A. leucophlœa* Willd. occurs, *velvelam* is found throughout India without intermediates. It occurs also in Ceylon and parts of Burma.

According to Willdenow (1809) *Mimosa alba* Roxb. ex Rottler et Willdenow—in *Gess. Naturf. Fr. Neue Schrift.* IV, 208 (1803)—is the same as his *Acacia alba*, which he does not consider a synonym of his *Acacia leucophlœa*. De Candolle (1825) also considers these two species as different. The legume of *Acacia alba* Willd. is described by him (De Candolle) as compressed, linear and tomentose. This species with the tomentose pods, though erroneously included under *Acacia leucophlœa* Willd. by Hooker and other botanists, should therefore be Willdenow's *Acacia alba*. But some of the later

Fig. I

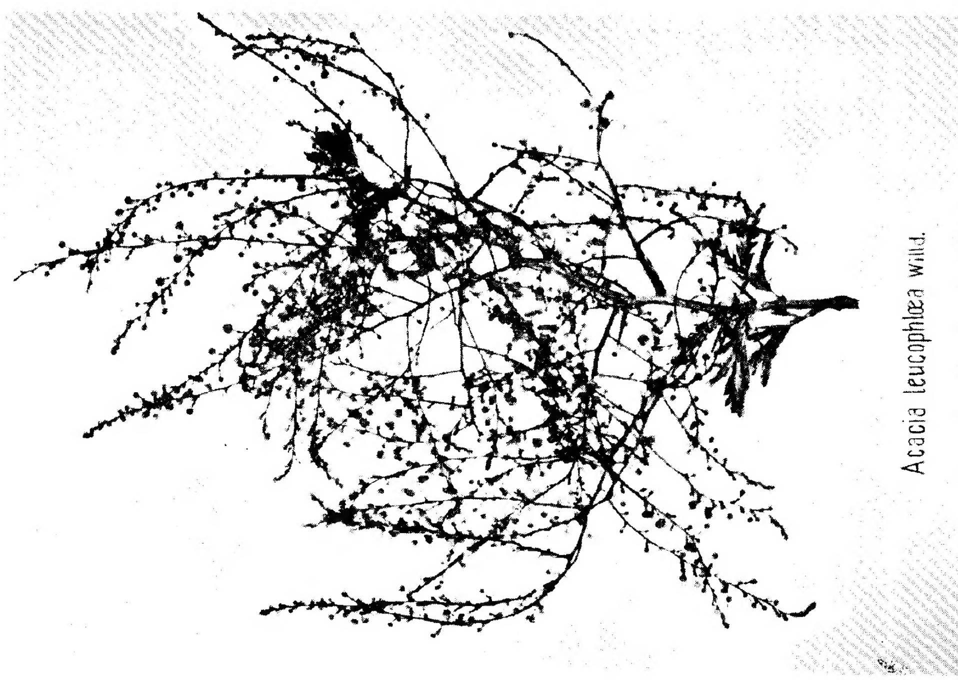
Tree with spreading and drooping branchlets and inflorescence in *Acacia leucophloea* Willd.

Fig. II



Tree with erect and stiff branchlets and inflorescence in *Acacia alba* Willd.

Fig. I



Showing the slender and spreading inflorescence in *Acacia leucophloea* Willd.

Fig. II

Showing the erect and stiff inflorescence with comparatively large flower heads in *Acacia alba* Willd.

botanists, viz., Wight, R., and Arnott, G. A. W. (1834), Hooker, J. D. (1879), Jackson, B. D. (1895), etc., consider *Acacia alba* Willd. as a synonym of *Acacia leucophlœa* Willd. The following botanists have erroneously called the plant with the tomentose pod and the associated characteristics as *Acacia leucophlœa* Willd: Beddome, Trimen, H. (1894), Cooke, T. (1903), Brandis, D. (1907), Parker, R. N. (1918), Gamble, J. S. (1919), Haines, H. H. (1921), etc.

Beddome, Brandis and Gamble have mixed up the two species and used both the local names, *tella tooma* and *velvelam,* for *Acacia leucophlœa* Willd.

With a view to clarify the confusion that exists in the descriptions of *Acacia leucophlœa* Willd. by various authorities, the author has studied the two species closely in their natural habitats, in the various parts of the Madras Province and also examined all the material available in the Madras Herbarium, Coimbatore. The study has led to the definite conclusion that the form with the tomentose pods is different from *Acacia leucophlœa* Willd. Therefore the idea of the occurrence of tomentose pods in true *Acacia leucophlœa* Willd. can be abandoned.

These two species are found without intermediates in well-defined geographical regions and are not seen anywhere growing together.

Acacia alba Willd. which has been considered by many botanists as a synonym of *Acacia leucophlœa* Willd. is a valid species (Madras Herbarium Nos. 85664 and 85665). The types of both these species of *Acacia* are not available in this country.

There is an *Acacia alba* De Vriese described in *Miq. Pl. Jungh.* 270.—Malaya (*Index Kewensis,* Vol. I, p. 6). But this species is not found in any of the floras of Malaya and may, therefore, be a *nomen nudum.*

Full descriptions of *Acacia leucophlœa* Willd. and *Acacia alba* Willd. are given below as the original ones are meagre.

Acacia leucophlœa Willd. (vide Plates 1 and 2).—A small tree with whitish bark; branches spreading. Leaves 2-pinnate, 4—9 cm. long; main rachis glabrous with a gland between the last pair of pinnæ and in most cases between the basal pair and very rarely between the last but on pinnæ. Spines long, straight, .5—2.5 cm. long; pinnæ 3—9 pairs, petiolate, 2—2.5 cm. long. Leaflets 4 mm. by 1 mm., 14—23 pairs, sub-sessile, linear, oblong, obtuse or obtusely rounded, nearly glabrous, closely set on the rachis, rachis and petiolules very sparsely pubescent. Flowers in large terminal panicles. Panicle slender, spreading, drooping and pubescent. Heads globose, 4 mm. in diameter. Pedicel slender, pubescent, with a ring of bracts about the middle; calyx .75 mm. long, triangular, teeth short. Corolla 1.25 mm. long, lobes sub-acute. Pods 7—12 cm. long by 7—9 mm., thin, flat, sub-indehiscent, irregularly bent or nearly straight, glabrous, sometimes shining and occasionally ending in a mucro. Seeds 6—12. Telugu name: *tella tooma.*

Acacia alba Willd.—A moderate-sized tree with yellowish white bark. Branches erect, slightly pubescent when young; leaves 2-pinnate, 7—12.5 cm. long, main rachis pubescent usually with a prominent gland having a depression at the top between each pair of pinnæ but sometimes absent between the second and third pairs of pinnæ. Spines vary in length from .5—2 cm., straight; pinnae 5—8 pairs, petiolate, 2.5—4.5 cm. long; leaflets 5—8 mm. by 2 mm., 8—17 pairs, sub-sessile, linear oblong, obtuse or obtusely rounded, glabrous, closely set on the rachis. Flowers odorous, in large terminal tomentose panicles. Panicles stout, erect, tomentose. Heads globose, 6 mm. in diameter. Pedicels stout, tomentose, with a ring of bracts about the middle. Calyx .75 mm. long, trapezoidæ; corolla 1.5 mm. long. Pods 7—11 cm. by 6—7 mm., thin, flat, sub-indehiscent, slightly curved and clothed with brown tomentum, abruptly ending in a sharp mucro; seeds 8—14.

Local names.—According to Watt (1889), the following local names are in use: *velvelam* (Tamil), *shveta barbura vrikshaha* (Sans.), *safed kikar, rohani* (Hind.), *safed babul* (Beng.), *sharab ki kikar* (Duk.), *goira* (Uriya), *safed kikar* (Pb.), *arinj* (Raj.), *raundra* (Banswara), *renuja* (Bijeragogarb), *reunja* (Gond.) *hewar* (Mar.), *haribaval* (Guj.), *bilijali* (Kan.), *andara* (Singh.) *tanaung* (Burm.)

The differentiating characteristics of the two species are given below: —

Acacia leucophlœa Willd.	*Acacia alba* Willd.
1. Branches spreading.	Branches erect.
2. Panicles slender, spreading, drooping and pubescent.	Panicles stout, erect and tomentose.
3. Heads 4 mm. in diameter.	Heads 6 mm. in diameter.
4. Pedicels slender, pubescent.	Pedicels stout, tomentose.
5. Calyx triangular.	Calyx trapezoidal.
6. Corolla 1.25 mm. long.	Corolla 1.5 mm. long.
7. Pod glabrous and sometimes shining.	Pod clothed with pale brown tomentum.

My thanks are due to Dr. N. L. Bor, the Forest Botanist, Dehra Dun, for valuable suggestions.

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WHAT'S IN A NAME?

BY J. V. KARAMCHANDANI

What's in a name? It may as well be argued by some that though it is a convention to recognise slaughtered sheep as "mutton" still it does not cease to be sheep or lose its identity as such. But you have not the varieties of sheep as we have of *timbers,* and multiplicity of words for the same thing serves no useful purpose and tends to complicate the language and make it more difficult, particularly so in timber the language of which is to the consumer a foreign tongue.

Confusion of timber names has been a long-standing problem with timber users, but with the growing demand on all types of timber, including inferior species of junglewoods for war purposes, the timber users are up against the problem of getting the timbers they have indented for. There is colossal ignorance amongst the consumers about timber in general and the magnitude of it can well be judged from the fact that even the public institutes, not to talk of the general public, which have been buying and using timbers for decades do not know what *teak* is and have to take traders' word for it. If this is what is happening in the case of our most common and widely known and important timber, which can be readily identified, it is next to impossible for them to know anything of the rest of the most common timbers and very much less of lesser known timbers.

Here is an instance where a textile mill at Ahmedabad has been using *teak* for goodness knows how long without the slightest knowledge of its identity. It was being supplied to the mill as *"Wistar wood"* which in other words means "branch wood" or fuel. So long as the material supplied met with the requirements and served its purpose they cared little, but when once they realized that they could not get it in sufficient quantities they immediately sent a sample to me for identification and indicating sources of supply.

It would not be so bad if we had *aliases* but the real trouble starts when you get "misnomers." How would you feel if you order oranges and get apples? It is the same thing in *timber*—you may have to accept *vellapiney* (*Vateria indica*) in place of *teak* unless

you have been taught to distinguish one from the other as in case of fruit. It would need expert knowledge to tell *Burma teak* from *country teak* and one or the other from *Malabar teak*, but so is it with oranges—the only difference being that *timber is not so simple as fruit.*

Two well-known misnomers which we have in the Bombay Timber Bazar relate to *benteak* (*Lagerstrœmia lanceolata*) and *zaver teak* (*Tetramerista glabra*). It is not so much the former as the latter which is being used on a wide scale as *teak*. The trade is only following trade customs and the fault lies with the "accepted practice."

The other day I was called in to assist and advise the Chief Store Keeper of a civic body in the supply of timber as he was not quite certain whether he was getting what he had asked for. One of the leading timber firms of long standing and repute had given him to understand that *benteak* (*Lagerstrœmia lanceolata*) and *zaver teak* (*Tetramerista glabra*) were inferior varieties of teak from Malabar and had gone even so far as to throw in *vellapiney* (*Vateria indica*) as such in the lot.

Though *benteak* was one of the specified timbers, I failed to find any *benteak* amongst the stocks which consisted mostly of *vellapiney* (*Vateria indica*). Some of the other specimens shown to me were found to be mango (*Mangifera indica*), *salai* (*Boswellia serrata*), *savar* (*Bombax malabaricum*), etc.

On one occasion when I had to inspect *benteak* (*Lagerstrœmia lanceolata*) on behalf of the Supply Department, the contractor produced everything in jungle woods (mostly *vellapiney*) but *benteak*, and on being told so he was indignant. Had he not grown grey in timber trade to know what is what? Has he not been supplying it to so and so for a number of years? Was it not being accepted by such and such party as *benteak* and so on and so forth? Had there been some one else without the requisite technical knowledge or experience and not sure of his ground, he would certainly have been convinced by the contractor that what he was offering was *benteak*. I know even to-day it is a common practice and the buyer is none the wiser.

The same thing happened when I had to inspect *poon* (*Calophyllum inophyllum*). The material produced consisted of mostly

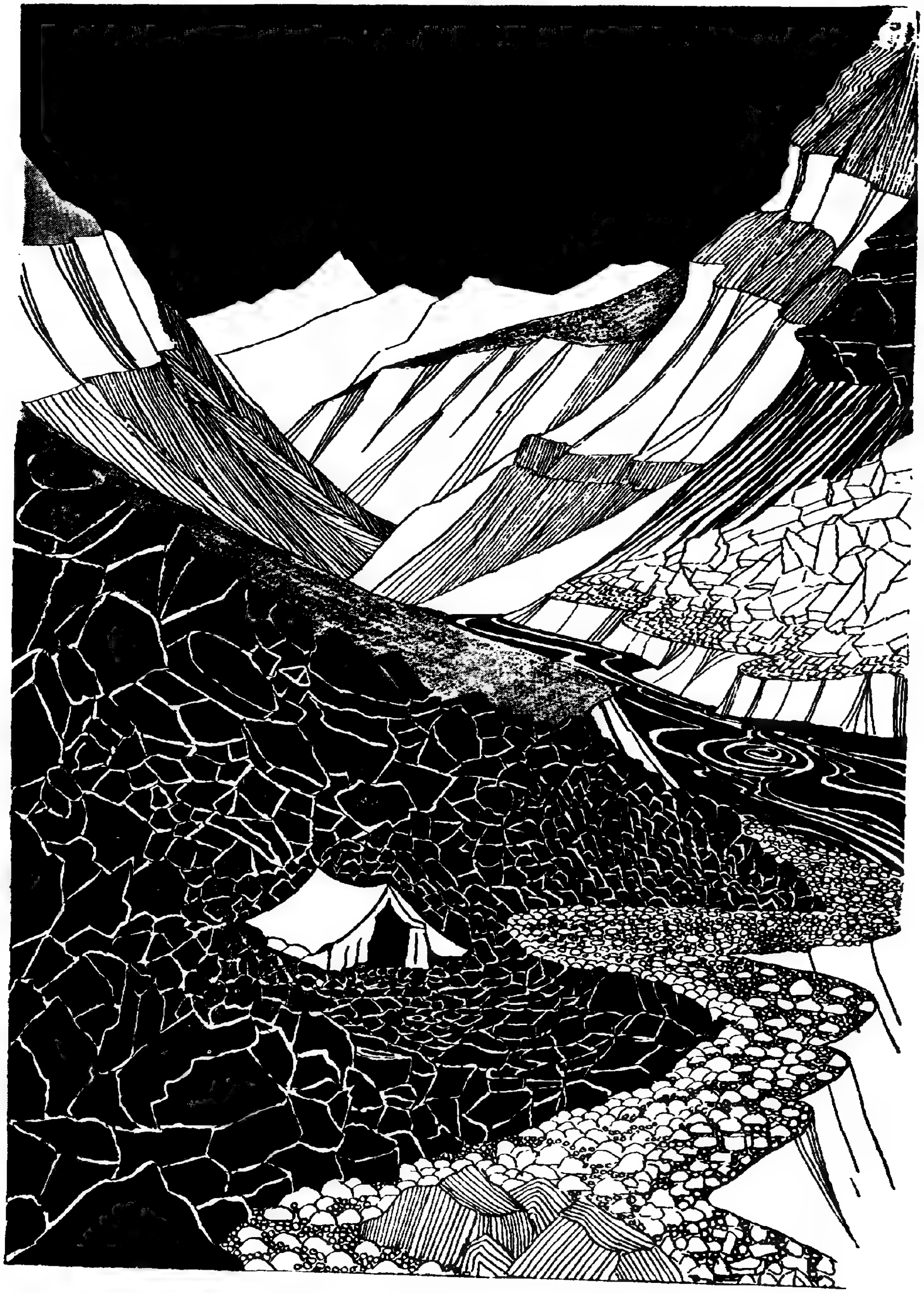
pali (*Dichopsis elliptica*) liberally mixed with mango (*Mangifera indica*) and other species of about the same colour. We had not only the same argument over this but this time the contractor produced his solicitor in the bargain to plead his cause. The contractor had ultimately to buy logs from the market to meet with the order.

It is an established practice that all conceivable junglewoods are being supplied, used and accepted as and in place of *country teak*. It is rather a bold statement to make, I know, but one does not need to go far to verify it. It is for every one with the most elementary knowledge of common timbers to see, if he goes about with his eyes open.

On one occasion, I have observed *savar* (*Bombax malabaricum*) being used as a responsible member of structure (King post) because it was baptized as country teak by the contractor. After all what's in a name? That which we call by any other name would smell as sweet!

The poor architect has to know about the other materials as well as timber. Not only is the number of those other materials increasing at an ever accelerated rate, but also the different kinds of these materials (like timber) is also increasing. He cannot be expert at every thing and I personally think that it is up to us, the forest officers, to see that there is some sort of standardization and that the use of a variety of names to signify the same thing is discouraged.

This is the time when we are trying to introduce some of our indigenous timbers in place of imported timbers and utilizing the same to meet with new demands made on timbers in general by war. It will do us more harm than good by recommending any timber unless we are satisfied that the right type of material is supplied and nothing else. Prejudices die hard and once a timber is found unsuitable it will remain as such though as a matter of fact, the stuff actually tried may not have been the genuine article but something else. Here is an instance: Messrs. General Motors Ltd., Bombay, who were recommended to try *poon* (*Calophyllum* spp.) in construction of lorry body-building, reported it as unsuitable for the purpose. On investigation it was found that the timber tried was not really *poon* but something else supplied as



Zingzingbar—Land of Hopeless Glory

poon by the contractor. Well, there you are. It shows how some of our good timbers are falling in disrepute.

Dealing with timber is not so simple as one imagines and identification of the same far more complicated.

One can also realize the apprehensions at the misapplication of these timber names, the names which have rightly or wrongly become generally recognized and in fact have come to form part of our technical vocabulary, and for the present and the immediate future there appears nothing to be done but to accept the inevitable.

It is up to us—the forest officers in general and Forest Utilization Officers in particular—to educate the public and put them wise to it and as a precautionary measure recommend every architect or consumer to possess a copy of "Official list of trade names of Indian timbers."

LAND OF HOPELESS GLORY—III

By E. C. Bor.

We had spent three weeks at the Crystal Palace in Kyelang, and had got ourselves quite comfortably dug in when we decided to uproot and make our way up to the Bara Lacha Pass, 16,000 feet high and three days' journey from Kyelang.

Knowing that we had a fourteen-mile march to Jispa—our first halt—we tried to make an early start from the Crystal Palace. But Lahoulis do not like early rising, and they do like to fuss and shout and talk and waste an incredible amount of time loading up the ponies. The gentleman in charge of the ponies was a bit of a swell. He affected a loud check jockey cap (much too small for his head) which he wore with the peak sticking out over one ear. He also wore enormous leather boots with no laces in them. We called him "Puss-in-Boots."

The journey to Jispa was interesting and beautiful. For the first three or four miles our road took us through a waterless land where a big forest of juniper clung to the desiccated slopes of the hills. The dry, twisted trunks of the junipers, their dead green foliage, and the dusty, stony steeps of the hills gave an impression of some forlorn, forgotten world. It was all so still and lifeless, the whole thing

brooded over by great black crags and sprawling glaciers that hung above the Bhaga river as it boiled away unseen, deep in its bed among the rocks and boulders far below the forest.

Not far from Jispa the hills swept back and the valley became wide and shallower, and we saw it spread out before us—a friendly, fertile valley planted with willows and poplars, and the river winding gently in spacious curves.

Jispa is a pleasant place, with a nice little Rest House standing among juniper trees. That evening a family party camped just in front of the bungalow. While the rest of the family went off to fetch firewood and gather the gossip of the valley, one old man was left to guard the camp, mind the baby, look after the dog, and keep the prayer-wheel turning. For a long time we watched him walking up and down with the baby slung on to his back while he never ceased to twirl his prayer-wheel, and only paused in his "Om Manis" when he spoke to the dog and bent down to adjust its chain that had got twisted round a paw.

On the whole these nomad people seemed to treat their animals with some sort of friendliness, if not definite affection—particularly their big sheep-dogs. It is possible that a dog's life in those hills is, at any rate, no harder than his master's, and we often noticed that a dog would show genuine affection for his master. There seemed to be an understanding between them which raised the dog far above the level of the village dog of the plains.

We liked these nomad people of the mountains. Particularly the shepherds in their homespun kilted dress, with their air of indifference to everything. As though life-long contact with the vast loneliness of the mountains had made all else seem trivial—except himself, his dog and his flocks. Here on the mountain trails you meet a people whose life is different from that of any human being. Bearded lads from Samarkand, people from Gobi and outer Mongolia. They are the true travellers, never knowing any other kind of life. No matter who you are, they greet you calmly as another friend of the road—one whose life naturally roves the same great distances as theirs. Their home is their yak-hair tent, the mountain passes are their club, the dusty, climbing sheep-track is their village street.

These we met off and on at intervals throughout our journey. When we left Jispa next morning, we met one of these shepherds walking ahead of an enormous flock of sheep. We asked him where he was taking them, for, as far as we could see, those desolate, dusty mountains held no pasturage for sheep. He opened his hand and flung it in a wide gesture that included a vast landscape of barren rock and mountain. "That," he told us, "is my jungle."

Four miles beyond Jispa we came to the junction of the Darcha and Bhaga rivers. Here four valleys meet to form a beautiful oasis among the mountains. The two rivers wind through fertile meadows among tall poplars and pollarded willows, with grassy slopes starred with meadow flowers. These were the last trees that we would see on our upward journey, for the shimmering green of those glades and meadows ceased abruptly as soon as we began climbing up the path on the further side of the valley. The path climbed steadily upwards and the mountains closed in on us again so that the Bhaga river was crushed into a narrow gorge, spanned in one place by a rope bridge—the ropes being made of birch twigs. It looked extremely unsafe.

Patseo, at twelve thousand feet was to be our next halt. We were rather dreading our night in Patseo. We had heard that at this time of the year a great annual fair took place there, so we decided that Patseo must be an important place. Bigger and noisier perhaps than Kyelang. We hardly expected to find swings and merry-go-rounds at Patseo Fair, but we visualised stalls and booths and merchandise, crowds of merry people (probably drunk), shouting of merchants, snorting and braying of animals, and plenty of barking dogs. We hoped that the Rest House would be decently remote from the village and all the fun of the fair.

So thinking, we wound our way up and round the interminable curves of the road that took us out of the green and smiling valley of the Darcha river. Thence onwards the country became more and more desolate, and the scenery wearily monotonous. Above 12,000 feet were no more trees and meadows, and very little grass. The soil became reddish in colour, and the rock-strewn valley twisted along between almost vertical slopes of barren stony mountains. The reddish brown monotony of the landscape was unrelieved even

by the gleam of glaciers or snow peaks, for we were too close under the mountains to see what was happening higher up. Like clumsy, crawling beetles we moved across a mirage-forming landscape where the sun, that blazed upon you from a sky that seemed too near, made the heat dance above the rocks and boulders, and where the sudden chattering of a stream made eerie music in that land of rocks and stone.

And so we came to Patseo. To this day I don't know what Patseo *is*. It isn't a village, for there wasn't one. It's not a district, for how could anyone call that place a "district?" Nor is it a river, for the only river is the Bhaga whose course we had followed up from far below Kyelang. In fact, the truth is that Patseo doesn't exist at all. You'll see it marked on the map all right, with the Rest House indicated definitely on the left bank of the river. But the Rest House (the only building there) is on the wrong side of the river. Which proves that there's no such place as Patseo. And in truth, when you get there (if it's possible to get to a non-existent place) your first thought is "I don't believe it," and then you laugh because it's all so absolutely impossible. Some might be more inclined to weep at the sight of so much desolation; for here, more than anywhere else on our travels, we had found the Land of Hopeless Glory.

The Rest House, small in any landscape, looked indescribably small and lonely, a tiny grey stone hut crouching among the rocks that sprawled and tumbled on the skirts of shaly steeps pouring down from a range of snow-capped mountains. Up every forsaken valley and all around us lay complete and utter desolation. Rocks and crags, mountain and cliff, everything before our eyes seemed to be disintegrating, pouring into the desolation their share of further broken rock and shale. It seemed that nothing, not even a louse, could find anything to live on in such a dead and stony place. But it was beautiful. Even when he built the forlorn little Rest House and flung an iron bridge across the river man had been unable to ravage the beauty of that wilderness. It was a mad desolation of rock and stone and mountain, but the sheer savagery of the place, its unfriendliness and its hardness flung a challenge to man—the one creature on earth able to destroy earth's loveliness.

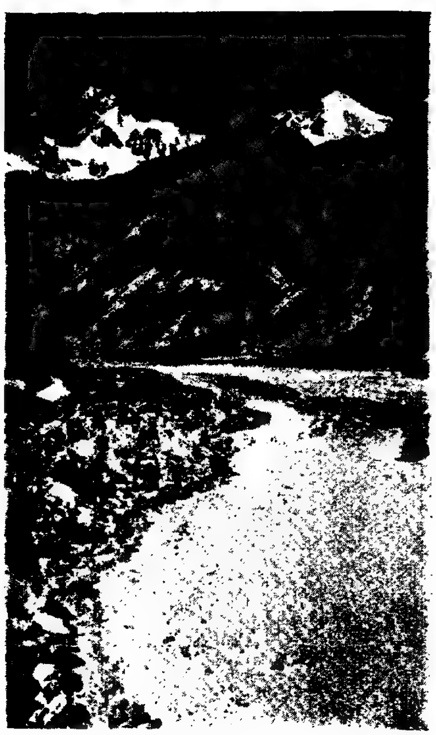
Fig. I

The Bara Lacha Pass

Fig. II

Looking across Kenlung

Fig. III



Above Zingzingbar

Fig. IV

Valley of Shattered Rock

We looked round for signs of the great Patseo fair. In such a place, where among all the rocks would people have a fair ? And why ? The stalls, the crowds, the barking dogs—we need not have worried. Patseo Fair consisted of a few tents pitched among the stones beside the river, and here the wool of Ladakhi flocks is exchanged for grain from Lahoul. Three valleys meet here ; so, presumably, it is a convenient market for the nomads whose homes lie anywhere among the vastness of this mountain region.

As nothing but stones grow at Patseo, no fuel is available there, so we had to bring our own wood all the way from Jispa and carry it along with us every day after that. But the following day we had only six miles to go to our next halt—Zingzingbar.

Patseo had come nowhere near our imagined picture of the place, but Zingzingbar was more or less what we had expected. With a name like that it couldn't have been anything else. And the desolation of Patseo was like a garden party compared with the devastation of Zingzingbar.

As I said of Patseo, I repeat of Zingzingbar—I still don't know what Zingzingbar is. Certainly not a village. There was nothing at Patseo to deserve a name, but at Zingzingbar, at 14,000 feet, there was less. Perhaps Zingzingbar is a curse. Or a prayer. The place that bears the name is a cataclysm. There is not even a Rest House there. Just a long low *serai* built of grey stones that look as though they had huddled themselves together seeking bleak comfort in that awful valley of smashed rock and splintered shale. When we arrived at 11 A.M. the sun's heat was almost unbearable. It blared down with brassy fury and blazed back from the rocks till the shaly dust of the pathway burned through your shoes. There was no shade anywhere, except inside the tent, and the heat inside the tent was suffocating. Everything in that valley happens with such uncontrolled fury that no sheltering rocks survive. Everything has been ground down by ice, smashed into fragments, hurled down from the glaciers—till the floor of the valley is littered with tumbled boulders, smashed rock and sharp splintered shale (Fig. IV, Plate 4).

The prevailing colour was a brownish red, like old bloodstains, with a sharp white light struck off its edges by the glinting rays of the sun. Almost verticle screes of shale and rusty broken rock came

pouring down from scowling crags another three or four thousand feet above the valley, and here and there above the crags a white peak soared into the hard blue of the sky.

The complete devastation of Zingzingbar was shattering. Or it would have been if everything hadn't been shattered there long ago. Everything, that is, except the snowfields and the glaciers that lie high above the valley, calm, white and indifferent, imperturbable cause of all the destruction in that Land of Hopeless Glory.

We had intended halting a second day at Zingzingbar, but the discomfort of the tent amongst those sun-scorched rocks decided us to go on and over the Bara Lacha Pass.

From Zingzingbar to the top of the pass is not nearly so heart-breaking as the journey from Koti to the top of the Rohtang.

We had only about five-and-a-half miles to go, and another 2,000 feet to climb, and our path meandered gently up among the rocks and screes. The scenery was monotonously like that of Zingzingbar all the way. That is to say, it was harshly beautiful, but not spectacular now that we were getting used to the bombed appearance of this gorge. At the top of the pass we came to a lake whose name was Tso Pam Tsi. The name suited it. It lay there glassily still and indescribably lonely, reflecting the curves of the dreary hills that rose above it.

One of the most striking features of the country beyond the pass was the wonderful colour effect of the rocks and hills—rich shades of chocolate brown and cream, and cones of detritus sparkling with colour that is stressed by the clearness of the air.

Further on, in the wide valley that stretches on to Lingti, we found patches of clayey soil among the débris of smashed rock. In one place the soil was white and squared into a weird effect of diamond pattern. Here we found saxifrage growing, buttercups and lousewort and edelweiss; and funny woolly looking compisitæ. Out of a glacier here a wide stream flowed, later on to become the Yunnan river.

From the Bara Lacha, valleys go off in all directions, and the Chandra, the Bhaga and the Yunnan all have their headwaters here, yet there is no startling vision of other worlds as seen from the top

of the Rhotang. Further beyond the pass the devastation of shattered rock lessened, and the scene became less crack-of-doom-like and dreadful. It was all very vast and very lonely, but not so angry—except for a fierce and cutting wind that blew down the valleys. It was very cold here too—and peaceful—like a valley among dead mountains in the moon.

We had about three miles of this lonely peace and then we came to the Yunnan valley and were drawn again into the strife of shattered rock and shale. At one part here the river widened into a shallow lake the further end of which was blocked by a most tremendous rock-fall. Vast blocks of sandstone rock had come hurtling downwards in some former day. The sight and sound of it must have been a wonderful thing. The road to Kenlung, our next halt, was built over these blocks of sandstone. We saw that the lake was being now filled up by masses of débris brought down by a raving glacier stream.

At Kenlung we came into a blizzard, and the cold was fearful. We were hard put to it to defend ourselves against the bleakness of Kenlung, and were driven to using the tea-cosy as a head-dress. Tied on with a pair of stockings a scarlet tea-cosy has a Balaclava helmet beaten to a cocked hat. Even the water in our tents froze at Kenlung.

We had by this time given up expecting to find any village or group of houses to justify the existence of a Name among these barren valleys, but Kenlung at least could boast an isolated character of its own (Fig. II, Plate 4). It consisted of a tiny oasis of green growing things, a serai, a supply-house and a bridge that had been washed away before we arrived. We also found Himalayan marmots here, lively, attractive little creatures who used to sit up among the rocks and let out queer little lonely calls to each other. We could hear them calling very early in the morning. The marmots proved that there must be some sort of vegetation growing there among the wilderness of rocks. But it would need a marmot, a yak or a botanist to find it.

In the country round Kenlung the rock destruction was not so violent. Time had done the work more gently, preferring to form a kind of soil by wearing down the rocks rather than bursting them

into slabs and fragments. On either side of the river was a widish plateau of almost bare earth, while the river ran below in a deep cleft fed by glacier streams. This desolate valley from Kenlung goes on to Lingti (which is a name and nothing more) and Serechu on the other side of the river, where there is a serai. Here, in an atmosphere of startling clearness, one finds an expanse of open country 16,000 feet high stretching away to the barren mountains that fringe it round. The plain is flat and featureless and almost destitute of any form of vegetation. There is not a tree anywhere to break the monotony of the landscape—just an occasional thorny bush, the only source of firewood for travellers, and vivid masses of gentian.

Although this high and desolate land is uninhabited, one seldom lacks for company on the road. All along the way we met Ladakhis, and strange woolly people from Yarkand and Rupshu. The Ladakhis were far pleasanter than the Lahoulis. We found both men and women friendly, merry folk always ready to share the camaraderie of the road.

The Bara Lacha and the remote valley on beyond form one of the highest and the loneliest highways of the world (Fig. I, Plate 4), and those who go that way spend their whole life travelling to and from incredibly far off places in Central Asia and beyond. Language difficulties form no barrier to friendship there. You are all fellow-travellers and you exchange greetings in whatever language is natural to you.

Our conversations with our nomad friends usually opened with the Tibetan greeting—"Ju lé." Then would come a flow of Tibetan from the Tibetans or Ladakhis, to which we replied "Shabash" or "Achcha," which seemed satisfactory. Then off you went on your different ways, and your latest friends dwindled to tiny specks of brown or black moving across the immense loneliness of the valley.

The Ladakhi ladies, with their turquoise studded head-dress and wide fans of matted hair, were decidedly fetching, and perhaps a little cleaner than the ladies of Lahoul.

On our last morning before starting our return journey, we watched a party of Ladakhis breakfasting outside our tent. Breakfast consisted of bowls of tsamba and dishes of buttered tea. They allowed the buttered tea to spread all over their faces like face-cream

(a good protection against frost or sunburn) and they kept their tea-pot hot by means of goat-skin bellows applied to a fire of thorn twigs.

We left them there absorbing their buttered tea while we started back on our journey across the pass, downwards through the grimness of the Zingzingbar rocks, and onwards through the valleys towards the Crystal Palace, the collapsing walls and the lights and laughter of Kyelang.

THE PROOF OF CLIMATIC CHANGE

By W. D. M. Warren, I.F.S.

Summary.—From the Forester's, and perhaps the Agriculturist's, point of view, temperatures, relative humidities, rainfall and rainy days, even drizzles under one-tenth of an inch, and heavy dews in the tropics are important factors to study for the proof of climatic change.

Of these factors rainfall change is the most difficult to establish, as the annual or seasonal fluctuations may be greater than the changes which the change of ground cover produces. This article shows how a knowledge of the length of the climatic rainfall cycle enables annual fluctuation in graphical form to be smoothed out, thus facilitating the detection of rainfall change.

Readers who have followed the articles written on the climatic effect of contour trenching arid hill slopes will have noticed that so far nothing has been claimed as having been proved, and that the effects have been described only as showing "tendencies" or "indications." From these descriptions many will have realized that climatic study is a long-term one and that quick proof cannot be expected. Some may perhaps be curious to know how long it will take for these "tendencies" to harden into proofs. In any case it is important for the Research Worker in Bio-climatology to realize what difficulties have to be overcome and what are the criteria by which climatic changes are judged.

Definition of Climatic Change.—What exactly is meant by climatic change? That question was put to the Meteorological Department, Poona. It was suggested to them that men sweltering in the heat of the tropics, might be content with a change which lowered the temperatures to a more bearable point! Nor would they mind if in so doing relative humidities were raised, as with a *khas-khas tatti*! (In that case the climate of the room might be said temporarily to have been changed!) In reply, it was stated that "a climatic

change may mean a change in any of the elements which go to make up the climate of a place, such as temperatures, humidity, cloudiness, rainfall, etc., but as the several elements of a climate are inter-related, a change introduced in one of the elements may induce changes in others."

From the forest point of view in the tropics, lowered temperatures and raised humidities in the height of the hot weather, quite apart from any increase in rainfall, would, by lessening the desiccating effect, be of undoubted benefit to *sal* and other forest seedlings, increasing their changes of survival. Raised relative humidities would also increase the tendency for dew deposition, giving similar benefits, as well as decreasing the chances of forest fires.

Rainfall Change Preferred.—Most people, however, would perhaps only be satisfied if the change produced an increase in rainfall. Their preference for a change in this climatic factor is sound and easily understood, for apart from any increase in the earth's productivity, rain has an immediate and spectacular reaction on temperatures. A single sharp shower in the tropics will bring temperatures down at once by 20°F, giving immediate relief. No wonder in the height of the hot weather people exclaim: "I do wish it would rain!"

The converse, that lowered temperatures and raised humidities will also increase the chances of precipitating moisture as rain, is also true, but is less spectacular and less understood. People appreciate the advent of rain without understanding why it has happened, or may even attribute it to wrong sources. An excellent example of this was told me by Mr. Kendrew of the Geographical Department at Oxford, "Many people," he said, "believed that the North-East winds in England brought rain, whereas they were wrong. It was the warm South-West winds blowing across the Atlantic which brought the moisture, but it might sometimes take a cold North-East wind to precipitate it."

Study should be Monthly or Seasonal, as well as Annual.—A study of rainfall statistics for change should include the seasonal as well as the total annual rainfalls. The seasonal rainfall resulting in a better distribution of rain may show an increase before the annual, and may be of more importance, for example with *sal* on the

edge of the climatic zone, where rains of May and June, and perhaps September and October, are so important. Even in Bihar considered to be the climatic climax for *sal*, earlier rains are of great benefit to *sal* regeneration on the more arid slopes, and in addition in agriculture give a longer growing season for the rice crop resulting in heavier yields of straw and, perhaps, of grain.

Importance of Rainy Days.—No study of rainfall distribution is complete which does not include the number of rainy days, whether monthly, seasonal, or annual. A rainy day, ordinarily, is a day on which more than .1 inch of rain falls, although in Bihar we record separately days on which falls are between .01 and .09 inch. Even drizzles of less than .01 inch are recorded, as well as days of heavy dew, as being of forest significance.

Some observers consider the number of rainy days to be of equal importance to inches of rain, reducing both to one common factor, the "degree of wetness," according to Chipp's formula—

$$\frac{\text{No. of rainy days} \times \text{inches of rains}}{10}.$$

If only provincial recording stations are available in the neighbourhood, then one's study of local climate must be confined to rainfall and rainy days as published in the official Gazette, unless one establishes stations for oneself, where the all-India stations record temperatures and relative humidities as well.

Monthly Figures should be studied.—For the sake of convenience, to lessen the number of figures to be watched, several months may be slumped together, but in doing so important critical months must be singled out for special study. Thus in Bihar our seasonal periods at first were January —May, June—September, and October—December. Then the annual rainfall graph suggested that the month of May showed signs of improvement while *sal* regeneration difficulties emphasised its importance. Now it is considered that June, September and October might usefully be studied. The Poona experts go even further and suggest that our records should be kept monthly. It may entail more work but we must not grudge this.

The Sensitiveness of each Climatic Factor to Change.—Having enumerated and discussed the individual factors which act and react

on each other to build up the complex environment called "climate," we now come to a discussion of the ease or difficulty with which each responds to changed conditions. The case is well put by Dr. S. K. Banerji of the Meteorological Department, Poona, who writes: "The values of meteorological elements even at the same place and with constant conditions of exposure undergo fluctuations from year to year owing to various causes. It is only when definite trends, which are significant compared to random changes, can be shown to exist that we can say that there is a change in the climatic characteristics. Even in the favourable instance where meteorological data of individual stations extending up to 100 years or so are examined for secular trend, it has been found that there is no significant changes of climate, although portions of the data covering periods of 5, 10 and 15 years may indicate temporary variations." Dr. Banerji adds, "while it would be comparatively easy to demonstrate the influence of afforestation on temperatures and humidities, its effect on rainfall is much more difficult to establish because even under ordinary conditions the variations from place to place and year to year are proportionately much greater."

The effect of reading this expert opinion on the erratic nature of rainfall was at first most depressing. One felt like ceasing forthwith to probe into climatic statistics for signs of change. For who wants to toil patiently knowing that even at the end of 100 years results might still elude one's grasp (or one's successor's)! However, it was a comfort to know that temperatures and humidities, which are also very important in Forestry, are more amenable to discipline! Then came the remembrance that rainfalls of arid regions are extremely erratic, Karachi for instance, one learns, may get no rainfall at all one year, but fifteen or twenty inches the next! Perhaps Poona's generalisation was being influenced too much by their failure to prove climatic change in Sind, as the result of the Sukkur Barrage, just when they thought they had done so. Because Sind had failed to come up to expectations, did it necessarily follow that Bamiaburu and its neighbourhood would likewise prove as difficult, seeing that it is much more favourably situated, scarcely 150 miles from the Bay of Bengal and enjoying a moderate climate neither extremely arid nor coastal? These thoughts caused me to address

ANNUAL RAINFALL AT CHAIBASSA

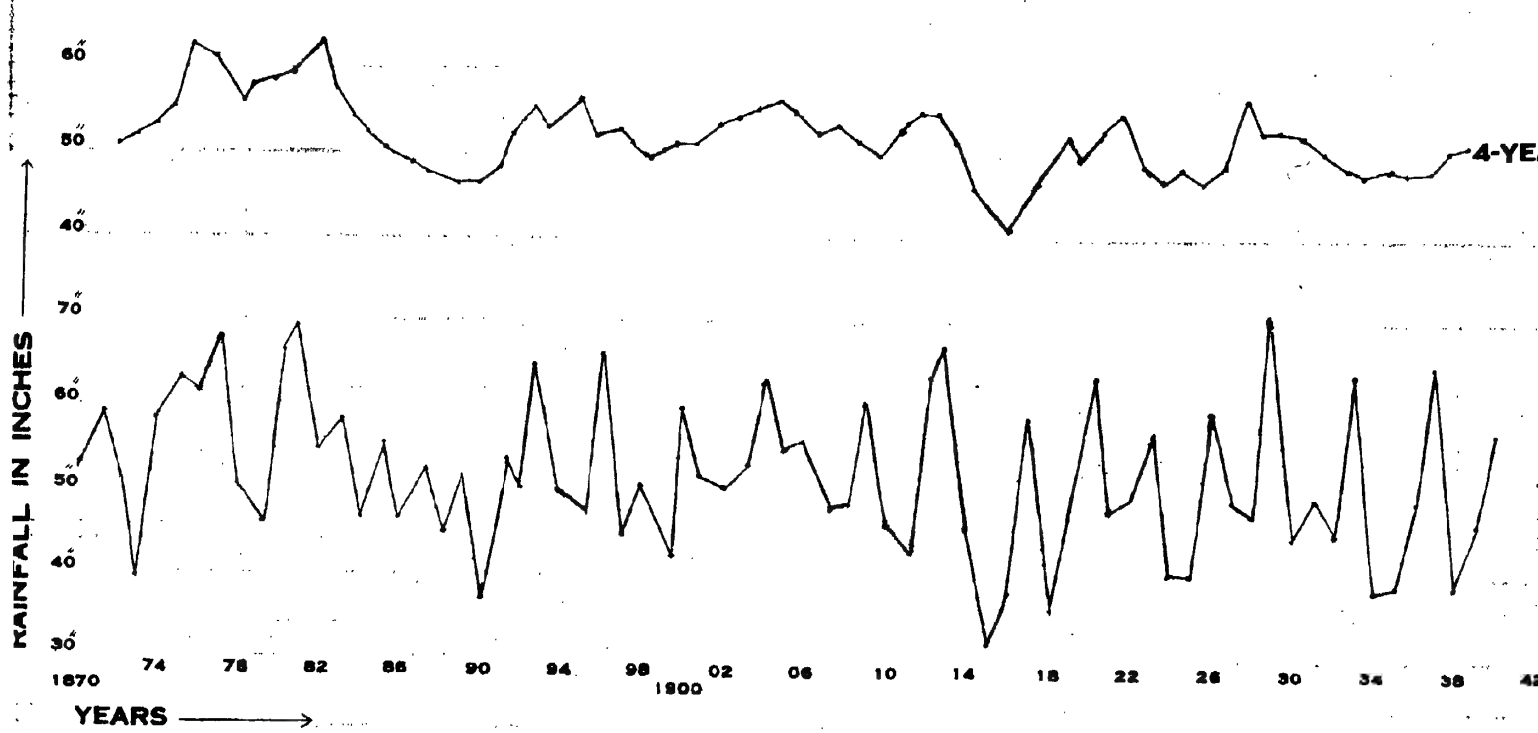


FIG. 2
4-YEAR MOVING AVERAG

FIG. 1
ACTUAL RAINFAL

the following question to Poona: "Is Dr. Banerji in his climatic generalisation referring to places comparatively near the coast, with a comparatively stable climate and a fairly heavy rainfall of 50—70 inches annually, or is he thinking of places in the Sind Desert where, admittedly, the rainfall is very erratic? For instance, the Chaibassa rainfall (nearest the experiment) has followed a regular series of peaks and depressions since 1891 on a fairly regular rhythmic cycle of four years!"

The following interesting reply from Poona well repaid the effort: "The remarks made by Dr. Banerji on the question of trends in a long series of data were based on an analysis of the data of many stations in different parts of the country.

"Variations in a time series like the rainfall of a place can be analysed into—

(1) periodic variations, and

(2) secular non-periodic or slow variations.

In experiments similar to yours, what one looks for is a permanent change of the secular non-periodic type. (2) If a periodic variation is present in the series, it is advisable to eliminate this before the secular change or trend is looked for. An approximate method of removing a periodicity of n years is to take n year moving averages

$$\frac{r_1 + r_2 + r_3 + \ldots r_n,}{n} \quad \frac{r_2 + r_3 + r_4 + \ldots r_{n+1}}{n} \ldots\ldots$$

and so on, where r_1, r_2, r_3, etc., are the annual rainfalls.

"Chaibassa's rainfall is available in this office from 1870, and a graph of its annual rainfall was prepared up to 1939 (*See* opposite page, Fig. 1).* An inspection of this chart does not show that there has been a *regular* four-year cycle of variation in the last fifty years. Intervals of three years from peak to peak of the rainfall graph are almost as frequent as intervals of four years. The series was, however, subjected to a simple periodogram analysis for finding periodicities, the trial periods ranging from 3 to 10 years. These results suggest a four-yearly period, the probability of which occurring by mere chance is of the order of 3 in 100. While this is suggestive, it will be necessary to examine the data of a large number of neigh-

* Since corrected up to 1940.

bouring rain-gauge stations before one can assert with confidence that the apparent periodicity of Chaibassa is significant and real and not due to mere chance.

"By taking four-year moving averages, the four-year periodic change, if any, would be removed; the resulting curve is plotted in Fig. 2. The graph shows irregular long-period fluctuations. Portions of the graph such as those for periods 1880—1890 and 1915—1930, when viewed independently, indicate a gradual decrease and increase of rainfall respectively during the periods concerned. But when the series is viewed as a whole, these changes lose their persistency and one cannot say that there is any tendency to a definite decrease or increase over the stretch of 70 years.

"If upon such a highly variable series a change is imposed, such as may be caused by trenching or afforestation, it will not be possible to assess the effect of the change within a short time, say five or ten years, unless the change is so abrupt and of such a magnitude as to stand out prominently in comparison with the natural fluctuations in the series.

"A climatic change may mean a change in any of the elements which go to make up the climate of a place, such as temperatures, humidity, cloudiness, rainfall, etc., but as the several elements of a climate are inter-related, a change introduced in one of the elements may induce changes in others. It appears from your letter that apart from a decrease in the diurnal variation of temperature, especially the lowering of the afternoon temperature, and the increase in humidity, which may be expected from afforestation, you are specially interested in a possible increase in the number of instability showers during the hot season. The best way of arriving at a definite conclusion on this point as well as on any changes of temperature and humidity, which the improvement in the forests may induce, seems to be to start observatories at two stations as suggested in Dr. Normand's D.O. No. A—3619/M-8, dated the 12th December, 1938. It would be necessary to keep for comparison of data, the two stations without change of environment for a period of two years, before attempting to change the environment of one of them.

K. R. RAMANATHAN.

In the above-quoted letter the Poona authorities have made a very important pronouncement. They indicate a method whereby rainfalls can be scientifically examined for secular trend without incurring the annoyance of controversy which has dogged our efforts so far. The smoothed out curves (Fig. 2) will show clearly and conclusively whether change has occurred or not. The method can be used for both monthly and annual rainfalls. They hold out the hope that if the change is sufficiently strong it may even show itself in from five to ten years so different from their former observation that we might wait one hundred years and then not prove it!

Chaibassa's climate having been more or less proved to follow a four yearly cycle of variation, it will not be necessary to examine its figures more often than once in four years, even for temperatures, humidities, and rainy days.

For the sake of scientific interest, it is also hoped that the two new forest recording stations suggested by Dr. Normand, will be set up. These stations would show the precise amount of change which contour trenching forests in a locality of 50 inches rainfall can produce. The Bamiaburu station cannot do this as it was established after the experiment had started, nor can the Roro station, established in the same year as the contour trenching of the neighbourhood.

I must confess, however, that great as the scientific interest of studying the effect of ground cover change on the forest climate undoubtedly is, I am even more interested in any climatic change which can be produced outside the forest itself as being of benefit to Agriculture as well as Forestry. That is why the study of Chaibassa's climate, ten miles from the forest edge and fourteen miles from the nearest point of the present contour trenching experiment, is so important. It piques me to be told by climatologists that they doubt if the forest influence on climate extends even to ten miles beyond the forest edge, when Chaibassa's "tendencies" and "indications" are *to the contrary. Poona's pronouncement* that changes introduced in one (or more in this case) of the climatic elements may induce changes in others, must also not be overlooked. It confirms what our experience had suggested. Finally, from a totally different and unexpected source comes very strong support for the view that we shall ultimately prove Chaibassa's climate to have changed. But that is another story worthy of another article!

SOUTH KHERI FOREST DIVISION SPORTS' DAY

BY S. A. A. ANVERY

An Annual Sports Day for the employees of a Forest Division! Something that they will look forward to every year, and something to be remembered in years to come! In spite of all its sylvan charms, the forest life is not an ideal one for a social animal. Eight months of exile every year with hard work and no play certainly makes most of our boys dull. I had toyed with the idea for sometime and in the end decided to hold a Sports' Day for the division in spite of advice to the contrary due to very short notice.

For South Kheri Division the selection of site was not difficult. Mailani was the obvious place. But fixing a date was a problem. My desire was to make it possible for every Forest Guard to participate. Throughout winter and spring most of us could not spare even half a day. During April and May fire danger was too great to be ignored. Rains would mean intensive work in *bankheti*, sowings and plantation. Fifteenth of June, therefore, was fixed for sports. Light showers had reduced fire hazard to minimum while it was not wet enough to start sowing and planting. Only one day was allotted for sports and no Travelling Allowance and yet the fact that without a single exception all joined the function *and went back to their charges the same night* proves their enthusiasm and zeal for the enterprise. More surprising than this was the fact that *every one* took part in something or the other and in most events two or more heats had to be arranged. Clerks of the office also took part in all events.

Cold drinks were provided during the day while after the prize distribution a dinner was given by Mohd. Shafi Ansari, Range Officer, Mailani.

It was due to the keenness of every one of the division and specially of Itrat Ali, Range Officer, Hirapur, that we could have such a successful day in the forest.

Early in the season (1941) I had announced that a medal would be awarded at the close of the fire season to the Forest Guard whose work in fire conservancy was judged best. This medal was awarded to F. Gd. Cheda Lal at the prize distribution for sports, and was in addition to the 59 prizes given away to the various successful competitors.

The Championship Cup for 1941 has been won by H. P. Bhola, Forester, and the Shield by the Hirapur Range. The first prize for Veterans' Race has been won by D. S. Bisht, Forest Assistant and the second by Itrat Ali, Range Officer.

TIMBER PRICE LIST, NOVEMBER-DECEMBER, 1941

(INDIAN STATES)

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing	*Tetrameles nudiflora*	Cochin	Logs	Re. 0-12-4 per c.ft.
"	"	Travancore	Logs	Re. 0-11-0 per c.ft.
Benteak	*Lagerstrœmia lanceolata*	Cochin	Logs	Re. 0-10-1 to 1-0-4 per c.ft.
"	"	Mysore	Logs	Rs. 1-4-0 per c.ft.
"	"	Travancore	Logs	Rs. 1-1-10 per c.ft.
Bijasal	*Pterocarpus marsupium*	Barwani	Logs	Re. 0-8-0 per c.ft.
"	"	Cochin	Logs	Rs. 1-0-11 to 1-7-5 per c.ft.
"	"	Dhar	Logs	
"	"	Holkar	Beams 14′×18″	
"	"	Hyderabad	Logs	
"	"	Mysore	Logs	Rs. 1-13-10 per c.ft.
"	"	Patna	Logs	
"	"	Travancore	Sawn material	Rs. 1-12-0 per c.ft.
Deodar	*Cedrus deodara*	Patiala	Sleepers 10′×10″×5″	Rs. 7-4-0 each.
Dhupa	*Vateria indica*	Cochin	Logs	Re. 0-12-11 per c.ft.
Gamari	*Gmelina arborea*	Tripura	Logs	Re. 1-0-0 to 1-12-0 per c.ft.
Gurjan	*Dipterocarpus* spp.	Cochin	Logs	Re. 0-14-9 per c.ft.
"	"	Tripura	Logs	Re. 0-8-0 to 1-4-0 per c.ft.
Haldu	*Adina cordifolia*	Bansda	Logs	Rs. 30-0-0 to 40-0-0 per ton.
"	"	Banswara	Logs	
"	"	Barwani	Logs	Re. 0-6-0 per c.ft.
"	"	Bhopal	Logs	Re. 1-0-0 to 1-14-0 per c.ft.
"	"	Cochin	Logs	
"	"	Dhar	Logs	
"	"	Mysore	Logs	Rs. 1-4-10 per c.ft.
"	"	Patna	Logs	
"	"	Travancore	Logs	
Hopea	*Hopea parviflora*	Cochin	Logs	Rs. 1-1-3 to 1-8-7 per c.ft.
"	"	Travancore	Logs	Rs. 1-7 2 per c.ft.
Indian Rosewood	*Dalbergia latifolia*	Bansda	Logs	Rs. 48-0-0 to 54-0-0 per ton.
"	"	Barwani	Logs	Re. 0-12-0 per c.ft.
"	"	Cochin	Logs	Rs. 1-3-1 to 2-3-1 per c.ft.
"	"	Dhar	Logs	
"	"	Kishengarh	Logs	
"	"	Mysore	Logs	Rs. 2-7-9 per c.ft
"	"	Patna	Logs	
"	"	Travancore	Logs	Re. 0-14-3 to 1-8-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul ..	*Xylia xylocarpa* ..	Cochin ..	Logs .	Re. 0-12-4 to 1-8-11 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-0-2 per c.ft.
Kindal ..	*Terminalia paniculata* .	Cochin ..	Logs ..	Re. 0-13-6 to 1-6-2 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 1-0-9 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-2-1 per c.ft.
Laurel ..	*Terminalia tomentosa* ..	Bansda ..	Logs & squares	Rs. 21 to 30 & 36 to 42 per ton.
" ..	" ..	Barwani ..	Logs ..	Re. 0-6-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Re. 0-14-0 to 1-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Re. 1-0-0 per c.ft.
" ..	" ..	Holkar ..	Sawn material	
" ..	" ..	Hyderabad ..	Logs ..	
" ..	" ..	Mysore ..	Logs ..	Rs. 1-6-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	Rs. 1-3-3 per c.ft.
Mesua ..	*Mesua ferrea* ..	Cochin ..	.	
" ..	" ..	Tripura ..	Logs ..	Rs. 1-8-0 to 2-0-0 per c.ft.
Sal ..	*Shorea robusta* ..	Cooch Behar	Logs & scantlings	Re. 0-12-0 & 1-8-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Tripura ..	Logs ..	Re. 1-0-0 to 1-8-0 per c.ft.
Sandan ..	*Ougeinia dalbergioides* ..	Bansda ..	Logs ..	Rs. 48-0-0 to 75-0-0 per ton.
" ..	" ..	Patna ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Banswara ..	.	
" ..	" ..	Cochin ..	Logs ..	Re. 0-12-4 per c.ft.
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-2-0 & 0-12-0 per c.ft.
"	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
" ..	" ..	Travancore ..	Logs ..	Re. 0-11-0 per c.ft.
" ..	" ..	Tripura ..	Logs ..	Re. 0-4-0 to 0-5-0 per c.ft.
Sissoo ..	*Dalbergia sissoo* ..	Banswara ..	..	
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-12-0 & 1-8-0 per c.ft.
" ..	" ..	Hyderabad ..	Logs ..	
" ..	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
Teak ..	*Tectona grandis* ..	Bansda ..	Logs ..	Rs. 30 to 90 per ton.
" ..	" ..	Banswara ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Rs. 1-8-0 to 2-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 1-5-6 to 3-1-3 per c.ft.
" ..	" ..	Holkar ..	Sawn material	
" ..	" ..	Mysore ..	Logs ..	Rs. 3-5-0 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Re. 0-14-9 to 2-14-6 per c.ft.

EXTRACTS

SUGGESTIONS FOR A PLAN

BY ALEXANDER RODGER

[Sir Alexander Rodger has very kindly sent us a reprint copy from the QUARTERLY JOURNAL OF FORESTRY, dated April, 1941, of his article which we have pleasure to reproduce below.—*Ed.*]

In a leader in *The Times* of October 16, 1940, the following sentence occurs:

"In the last War there was some temptation to look back to the world of 1914 as a golden age, and to suppose that the restoration of this world, amended no doubt in detail but preserved in essentials, would mean a return to an era of peace and prosperity. The present generation is unlikely to think in these terms of the world of 1939. This time the watchward cannot be the restoration of the *status quo*, but the rebuilding of the very foundations of our social and international order."

Fresh from the perusal of Mr. Colin Thompson's article "The Private Woodland Owner's Approach to a National Land Policy" in the QUARTERLY JOURNAL OF FORESTRY for July, 1940, these words from *The Times* seemed to the writer to be peculiarly apt. It must often have been in the mind of professional foresters that forestry in Great Britain, when the war is over and won, must be very different from forestry as at present practised in these islands. Unless we are prepared to make the most of our assets of every kind, we can no longer expect to be the leading partner in a great Empire and to carry out our duties in preserving that heritage. Our greatest assets are our people and their spirit, but we shall undoubtedly have to make the most of our material property if we are to keep our position in the world.

No one who has travelled much in Great Britain can fail to have noticed the derelict land which is to be seen in every county, sometimes of astonishing and deplorable extent, and it should be the task of forestry, side by side with agriculture, to see that this waste does not continue. The Minister of Agriculture told the Farmers' Club in December that the recent farm survey "has brought home to everybody the extent to which land had gone out of cultivation;

buildings had fallen into disrepair or even disappeared; drainage had become non-existent; and the general fertility of the land over wide areas had lessened almost to vanishing point.

"The extent of such land may be gathered from the fact that 'rough grazing' increased by nearly three million acres in the past thirty years, although there has been a heavy shrinkage of other agricultural land. Even since 1920 cattle on such land in Scotland had diminished to one-third and sheep to less than two-thirds of their former numbers."

It is not desired to put too much emhpasis on the good that forestry can do, or to claim for it too high a place in the future improvement of the country, but it can undoubtedly play its part and provide Britain with a large and ever-growing asset, and it will be really criminal not to make the most of this.

Reference may here be drawn to another interesting article by Mr. Thompson in the QUARTERLY JOURNAL OF FORESTRY for October, 1936. He quotes figures from the *Report on Census of Woodlands*, 1924, from which it appears that 400,000 acres of felled and devastated woodlands were still unplanted in that year.

Sir George Stapleton, in *The Land, Now and To-morrow,* has drawn attention to the fact that such areas are not suitable for anything but planting with trees, as the high cost of clearing and stump extraction will usually prevent them from being prepared for agriculture and their grazing value is very small. In the census report of 1924 it was estimated that sixteen per cent. (about half a million acres) of the total woodland area had been felled or devastated, forty-six per cent. of which was in Scotland, forty-one per cent. in England, and thirteen per cent. in Wales.

Mr. Thompson has in his article of July 1940 given a good description of conditions before and during the present war and has stated some of the facts relating to a comprehensive Land Policy. If Government intends to prepare such a policy for application after the war, now is the time, as Mr. Thompson says, and not later, for landowners to consider the whole question and be ready to put forward their views, and their views must be of importance because they still own a considerable part of the forest-bearing area of the

countryside. By "landowners" here is meant those who have holdings of sufficient size to warrant their taking an interest in forestry and not small holders and farmers, who are less directly concerned.

The "ignorance and indifference" to which marked attention is drawn on page 6 of *Estate Woodlands* should no longer be allowed to prevent the development of a potential and very valuable asset for the country.

It has been said that private ownership of rural land has broken down and a good many landlords have given up their land and taken their capital with them. This is due largely to social changes, but it is not too much to say that if agriculture and forestry can work together to help landlords to live on their property and continue to invest money in it, a great step forward will have been taken to ensure the proper utilization of all the land in the country.

Declaring that it was useless to talk about a long war unless more food was got out of the soil, Mr. Lloyd George urged, at a meeting of the Executive Committee of the Carnarvonshire branch of the National Farmers' Union of England and Wales, at Carnarvon, recently, that there should be a complete survey of the land. This would ascertain the quality of the soil and its possibilities, how it could be improved, the cost, what the State would contribute, and the prospects of keeping the labourer as well as the farmer on the land. We might have done it in peace-time, but it could be done even now.

If agriculture requires a comprehensive land survey, there can be no doubt that forestry requires it just as much. It may be that forestry and agriculture should work together in this survey more than they have in any branch of development so far, and it has been suggested that the improvement of private forestry should come under the Ministry of Agriculture and Fisheries. This Ministry could make use of the existing departmental machinery to organize measures for the wholesale improvement of private woodlands. The writer would, however, prefer to see forestry being cared for by a department or managing agency of its own, and is rather opposed to it being regarded as a handmaid to agriculture.

To mention only one objection, forestry must not be at the mercy of political changes, a point which has always been regarded as of

the greatest importance, as continuity of policy over a long period is the only method of assuring success.

Sir George Stapledon in his book already quoted, has made some sound remarks on the necessity for a land survey. In Chapter XXIV he puts the case clearly, the first point he makes being that no survey or inquiry can be regarded as complete unless it covers the whole country.

"A considerable body of information exists already; but it is scattered, unstandardized and diffuse, and has been collected by all manner of different persons for all manner of different purposes." He draws attention to the "gallant attempt" made under the directorship of Dr. L. Dudley Stamp to make a general survey. Sir George proposes that the 6-inch map should be the foundation upon which to base a complete survey, and this would suit foresters, who will have to deal with very small areas of forest in many parts of the country. Those who have seen the beautiful forest stock-maps produced in Finland, Czechoslovakia and other countries in Europe, will appreciate how good forestry can be stimulated by the intelligent use of large-scale maps. Dealing with the planting that has been done by Government to date, Sir George says: "From the point of view of land utilization as a whole, and a considered programme for the land, it would have been more in accordance with long-sighted policy to have concentrated first on the derelict woodlands."

He then makes some interesting remarks on the "balance of country" with particular reference to the afforestation of rough and hill grazings. He goes on to suggest that planting by Government on new land should be carried out either on much smaller or much larger units than at present, but it is necessary to remember that very small units are very difficult and expensive for a Government department to administer. He makes particular mention of the large area acquired by Government in the Border Country and expresses the opinion that this should either be much larger or much smaller, forestry being introduced over a considerable number of small areas as a complement to the work of the grassland improver.

It was recently announced in the House of Commons that the State proposes to plant about 26,000 acres this year, in continuation

of the programme according to which some quarter of a million acres have been planted; mostly with conifers, since 1920, and an article in *The Times* of December 24, 1940, seeks to show how the work done by the State has been justified by war conditions. The problem of the supply of home-grown timber has, however, not been solved by these measures. Apart from the fact that there are dangers, known to all foresters, in making large areas of pure conifer plantations, the concentration of State funds on this work has prevented an adequate allotment for the improvement of private forestry.

According to the *Report on Census of Woodlands* published in 1928 only about half of the three million acres of woodland in the country was occupied by "Economic or Potentially Productive High Forest." The other half of the area was occupied by coppice and coppice-with-standards, scrub, felled or devastated, and uneconomic (including amenity woods and shelter-belts).

It appears to be generally agreed that the system of grants given to private owners for planting has not led to much improvement.

Two extracts from the same report are very disquieting:

"When the existing mature and semi-mature oak woods have disappeared, as they are steadily doing, the supply of home-grown oak will become negligible."

"There was distinct evidence in the woodland censuses of 1905 and 1913-14 that the total area of woodland was steadily diminishing. The average rate of planting from 1884 onwards had been about 12,000 acres per annum, which was roughly about 50 per cent. of the rate required to maintain the nominal woodland area in a good state of productivity."

Another point of importance in connection with the planting programme may be mentioned and that is that when working up a first-rate technical department from the start, the staff, both supervisory and executive, should be given opportunities of wide experience of working plans and of silviculture of all kinds. The lack of this experience, owing to the concentration on afforestation, had led to the neglect of some of the older Crown woods and to the failure of the staff to acquire the knowledge required to make them skilled advisory officers.

To bring the matter of the supply of timber up to date, on January 28, 1941, Lord Phillimore drew attention in the House of Lords to the heavy imports of timber and to the apparently insufficient use of home-grown timber. The reply of the Joint Parliamentary Secretary, Ministry of Supply, can hardly be considered satisfactory. He acknowledged that little home-grown timber was produced at the beginning of the war and it certainly seems very late in the day to try to induce "the various departments to take in their specifications hardwood from England rather than imported wood."

The cure for all this distress seems to be in the hands of the private owners themselves and they must work out their own salvation because they can do it better than any Government department.

Starting from the very important declaration that only in the worst cases will the State use the powers it possesses to take land away from an owner of woodlands, the writer would next like to state that divided ownership, or sharing of profits between the State and private woodland owners, should never be approved. He believes that in such cases the State will nearly always be left to carry the baby, and when the war is over, it will have quite enough other babies to carry.

Considering the case of an approach to a landlord who is indifferent to forestry, and should be converted, he may say that he will take it up if

1. It makes his property more valuable and helps him to make it pay.
2. It makes his estate more pleasant to live on.
3. It does not spoil the shooting.
4. It will afford shelter to crops and stock.

He may very likely bring forward a number of objections.

1. My woods are in small scattered blocks and are thus very difficult to manage scientifically and economically.
2. I cannot get good professional advice and my area will not bear the cost of a whole-time trained forester.
3. I cannot get a decent price for my timber when I have some to sell and no one will tell me where to find the best market.

4. My agent does not know or care much about forestry.
5. I find it difficult to get good woodmen to work for me.
6. Without financial aid I cannot afford to spend anything on my woods. I do not receive enough from them to put anything back.

It is of the utmost importance that something should be done without delay to reassure and to help the private owner of woodlands, to assist him to keep his land and to offer him undisturbed possession and enjoyment of it, if it is properly managed.

Mr. G. M. Young, writing in the *Sunday Times* recently on "The New Landed Interest," in a letter to the Editor, said:

"At the head of the new interest stand the leaders of agricultural science and the scientific landowners and farmers. But behind them, I am sure, is a great body of opinion, neither scientific nor always practical, but very willing to be instructed, and capable, if properly organized, of carrying weight when our future agricultural policy comes to be determined.

"There are, so far as I can see, two particular dangers before us. One is that when the immediate crisis is past we shall relapse into indifference. The other, that the field will be occupied by contending parties with no informed opinion to which they can address themselves or by which they can be controlled. When it comes to counting heads, the town must always win against the country, and the future of our agriculture therefore depends on the town knowing what the country is there for, what it can do, and what part it can play in sustaining a healthy population and a balanced national economy.

"In comparison with this fundamental, organic issue, the sort of questions over which politicians of the last age grew hot—landlords and game laws and nationalization of the land—seem trivialities; to some of us, irrelevant trivialities.

"I should, therefore, like to urge on the leaders of this great industry the importance and timeliness of such an organization. People are very willing to be informed if they can trust their informant; and they readily distinguish between instruction and propaganda. Looking back over the past century, I see that some of the most important and acceptable changes were preceded, and

brought about, not by political agitation but by plain, persistent education carried on by men who had no personal or party interest to serve, by small groups becoming large groups, and large groups becoming powerful societies.

"That is the process I should like to see set going now—now at a time when interest is alert, when experiments are rife, and information is more abundant than ever before, when party interests, if not perhaps quite in abeyance, are at least in healthy subordination to the national welfare."

Nothing could be more applicable if it is really desired to make a good start in private forestry. Mr. Cripps, writing to the same paper in the issue of November 24, 1940, said:

"The good farmer is the man who can make a profit out of farming on the land he occupies and not necessarily the highly educated man who can tell you for certain how it should be done."

For "farmer" read "forester."

On December 13, 1940, *The Times* contained the following announcement:

"Helping Hill Sheep Farmers—Subsidy to Cost £700,000

The new subsidy to assist hill sheep farmers, announced in the House of Commons yesterday by Mr. Ernest Brown, is expected to involve an aggregate payment by the Government of some £700,000 between now and next autumn.

It was decided that immediate assistance was necessary to tide these farmers over a difficult period, and a subsidy of 2s. 6d. is to be paid in respect of each breeding ewe in hill flocks, including shearling ewes and gimmers. Although the scheme applies to England and Wales as well, more than half of the £700,000 will go to Scotland, where hill sheep farming plays a more important part in agricultural economy than it does south of the Border.

Bracken Cutting

A sum estimated at about £250,000 is also to be paid by the Government over a period of years to encourage the hand-cutting of bracken in Scotland. There is to be a grant of 50 per cent. towards the agreed estimated cost of clearing ground by hand. This will supplement the existing Government scheme for assisting the purchase of bracken cutting machines. By a vigorous campaign it is

hoped to clear of bracken 500,000 acres of land which could be made profitable for grazing. Similar measures are to be introduced for clearing land of bracken in England and Wales."

Now why should private agriculture have these large sums allotted to it when private forestry is starved and would be contented with a much smaller financial encouragement?

Let us suppose that the principal private woodland owners have got together and considered and produced a definite policy, not for postponement and meetings months ahead, but for immediate action.

They would by personal contact awaken the interest of as many woodland owners as possible and would make the first advance if they announced the following steps to be taken, not dogmatically or dictatorially (no dictators are wanted in forestry) but as among friends who know each other's difficulties:

1. Assistance will be given in the management of your woods, however small and scattered they may be, so that they may produce as much good timber as possible. It is intended to provide both professional guidance and financial assistance.

2. Professional supervision will be provided in the shape of a trained forester. If you cannot pay a whole-time man, he will be in charge of several estates and his salary will be divided in proportions corresponding to the area of woodland on each estate.

3. Every endeavour will be made to provide skilled labour by inducing young men to learn the work under competent foremen. It cannot, however, be expected that this labour will be cheap.

4. By means of co-operative marketing, the produce of your woods will be sold in the best market.

5. First-class training will be given

(*a*) To agents and others, by means of classes to be held at one of the forestry training centres in the kingdom such as Cirencester, Oxford, Cambridge, Bangor, Edinburgh and Aberdeen.

(*b*) To young men who will become foresters. A training school or schools similar to the Government training centre in the Forest of Dean will be established.

6. Legal advice will be provided so that agents and owners may understand how taxation affects woodlands. It has been

stated by a good authority that, practically speaking, woodlands do not now pay Death Duties, if the property is well managed. A proposal that the amount of the Death Duties should be allotted for expenditure on improving the estate would appear to have little chance of approval by the Treasury.

Assuming that these proposals have been put before and have received the approval of a substantial number of woodland owners in the country, the conference or managing body would then be in a position to approach Government and put the case for financial assistance somewhat as follows:

We believe that, with the assistance of Government, all the privately owned forests in the country can be made to produce a satisfactory quantity of good timber, both softwood and hardwood, for many years to come, and further that many waste lands and old and derelict woodlands can be brought into profitable bearing. To ensure these results the following proposals are made:

1. The State will provide an adequate sum of money annually. This money will be at the disposal of the body which puts forward these proposals, Government interest being represented on the governing body by a senior experienced official. The book-keeping will be in the hands of a first-class firm of chartered accountants.

2. Every effort will be made to ensure that woodland owners repay to the State the advances they receive, whatever form the advances may take. They may be given in the form of cash, or professional advice, or supervision, or the loan of a tractor, or the services of a skilled merchant or engineer, and in other ways. The method by which it is proposed to enable the landowner to be in a position to repay the advances is described above, but under no circumstances will any endeavour be made to keep an unsatisfactory estate going with Government money.

The money having been obtained, the governing body will allot it for the following work:

1. Owner and agents will be invited to attend classes, as recently held at Cirencester, where lectures on the principles of forest management will be given. Those who have the time

and inclination will be encouraged to take degrees in forestry at Oxford, Bangor, Edinburgh or Aberdeen or to attend the estate forestry lectures at the School of Agriculture at Cambridge.

2. Training schools will be established for foresters, who will be selected by the governing body and will take a two years' course planned on the lines of the training given at the government schools in the Forest of Dean and at Benmore in Argyllshire. Woodland owners will be allowed to send their own men to one of the schools provided they are sufficiently well educated and not too old. If such owners can make a good case, the school fees will be paid. The governing body will undertake the supervision of the schools and lay down the standard of training that should be observed. Men who qualify will be given a certificate. Outside examiners should be employed.

Every man who passes out will be given employment at a satisfactory salary. It may be advisable to have a graded list with annual rises of pay and perhaps a pension scheme.

Particular care will be taken to see that the interests of the small owner are not neglected, and, as proposed above, one man may be put in charge of several estates.

3. Provision will be made for the supply of adequate skilled labour. It must be acknowledged that this will be one of the most difficult post-war problems connected with forestry.

When demobilization takes place, there will be many young and active men in the country in search of work. Owners of land will know many of them and they should be asked to try and get some of them to take up forest work. It is not possible at the moment to propose any scale of wages, but this will certainly not be lower than that fixed for agriculture. Every advantage should be taken of the skill of the old woodland workers and they should be encouraged to hand on their valuable knowledge to younger men. Short courses of instruction may be thought advisable by the governing body, which will have to be in the closest touch with the organization of this essential body of labour.

4. The woods will be managed according to the principles of scientific forestry and the following alternative methods are suggested:

(*a*) The governing body could maintain its own staff of experts, who would each have charge of a tract of country, a county, so many parishes, or other units.

(*b*) There are at present certain firms who will fence, drain, cut bracken, etc., and plant. It might be possible to induce such firms to undertake the management of a woodland estate for a rotation, provided they have the requisite skill.

5. When forming new woods it would be necessary to have scientific plans for:

Selection of Site and Ecological Survey; Preparation; Draining; Fencing; Roads and Compartment Bouandries; Destruction of Rabbits; Establishment of Nursery (perhaps one for a dozen estates); Choice of Species; Planting; Weeding, Thinning and Pruning; Works of Natural Regeneration; Marking; Felling; Extraction; Conversion and Sawmills; Marketing.

Good maps, kept up to date, are essential.

All woods, however small, should have a working plan and it should be printed. A dozen small estates could have one working plan. There is no reason why expenditure on and revenue from each estate should not be properly allocated in such a plan. It may be necessary to have a special working-plan party and among its principal duties would be to ensure:

1. That large areas of woodland are not broken up.
2. That the annual yield should be constant.
3. That the provisions of each working plan should be very simple but must be followed.
4. That immature timber is not felled.
5. That full advantage be taken of the relief that taxation offers to woodlands properly managed, as fully described in the Society's pamphlet *Estate Woodlands*.

6. On estates where sport is of importance the game-keeper should be consulted and his wishes complied with if they do not interfere with sound silviculture. Every endeavour should be made to overcome the prejudice which exists against forestry among many sportsmen. Woods can be laid out so as to provide good and properly sited coverts and special attention should be

paid to the provision of mixed woods of different ages and the best undergrowth such as Gaultheria, dogwood, snowberry, Rhododendron, Berberis, privet, Viburnum, etc.

Rabbits must be destroyed on all woodlands and confined to warrens or other suitable areas.

Excellent advice about the possibilities of sport combined with good forestry is given in the pamphlet *Estate Woodlands,* and in Chapter XVIII (by the Hon. N. A. Orde-Powlett) in *Improvement of Woodlands,* by W. E. Hiley (Country Life Ltd. 1931). Closely allied is the question of amenity and on this point too useful practical suggestions are made in these two publications. Well-laid-out and well-managed woodlands should be an ornament to any estate, care being taken to use hardwoods as much as possible, even if it is only on rides and margins. Unrelieved blocks of conifers have got forestry a bad name among many people who love the beauty of their country.

7. Co-operative marketing on the lines already started would be essential. The expert would be in close touch with the silvicultural and working plan staffs and would know what would be available for sale at any time. Provision would be made for catastrophes such as gales and fires. An intimate knowledge of local and general markets would enable him to dispose of all produce at the best prices available.

8. The actual financial assistance to be given to owners would depend on the extent to which they took advantage of the facilities offered. It would be possible to lay down the scale of grants to be offered for improvement of derelict land, draining, fencing, planting, natural regeneration, and maintenance, possibly even until the end of the rotation.

It would probably be advisable to cease planting grants under the present arrangements.

The foregoing is offered to the members of the Royal English Forestry Society as the basis for a plan whereby woodland owners can work out their own salvation and remain masters on their own estates. The essentials of the scheme are expert knowledge, co-operation, and personal contact. Particular attention is invited to the pamphlet *Estate Woodlands* published by the Society in 1937.

PYRETHRUM IN KASHMIR

By M. R. Fotidar, B.Sc. Ag. (*Punj.*). M. S. Hort. (*Calif.*)
Director of Agriculture, Jammu and Kashmir State.

In 1937 the production of Pyrethrum in India was considered by the Imperial Council of Agricultural Research. Sir John Russell who was present at the meeting of the Advisory Board, stated that Pyrethrum could be grown in tropical, sub-tropical and temperate climates. The Council recommended that a co-ordinated experiment should be carried out at suitable centres in the country with a view to find out whether pyrethrum could be economically produced. Accordingly, the Imperial Council of Agricultural Research secured seeds of *Pyrethrum cineraræfolium* from the Director, Plant Pathological Laboratory, England, and distributed these seeds among the provincial Governments and constituent States for trial, in Kashmir, among other places. This was how the author undertook the experiments in cultivation of pyrethrum in the autumn of 1937 under the auspices of the Imperial Council of Agricultural Research. This is the third year of the plantation. The harvest of 1940 yielded about 22 seers of seeds besides half a maund of dried flowers for experimental purposes.

Description.—Pyrethrum cineraræfolium ordinarily resembles the field daisy, particularly the flower, which is similar in size, shape and colour. The plant is perennial and grows 18 to 20 inches high. Stems are unbranched and slightly hairy. Leaves are petiolate and finely cut. The flower heads consist of rounded receptacles, a straw-coloured involucre composed of three rows of scales and a disc containing numerous yellow flowers with a circle of yellow or cream-coloured ray flowers. The ray florets are ligulate pistillate with cream or white coloured corolla. These florets are delicately veined and exhibit three teeth at the tip. The disc florets are yellow, tubular, perfect and have each a five-lobed corolla borne on the ovary. The flowers vary from 2 to 6 mm. in diameter.

In the late autumn of 1939 and during midwinter after the snowfall experimenting planting was done at eight centres in the Valley (5,200 to 5,500 ft. altitude) under different soil conditions, both irrigated and unirrigated. The soil varied from light loam to clay,

barani (rainfed) lands, *karewas* (plateau dry lands), rice wet lands and land under fruit trees. This was done with a view to finding out suitable conditions under which pyrethrum could be grown successfully and at the same time economically, and also the minimum requirements of water and soil fertility. At three centres out of these eight manurial experiments were laid out for trial of farmyard manure and ammonium sulphate. Before 1939, experiments were made on viability and germination of seeds, methods of planting in the field, time of seed sowing and plantation and harvesting for seed and dried flowers. The preliminary results of all experiments have thrown light on the possibilites of this plant for its insecticidal value as a cash crop in Kashmir. The observations on the experiments so far carried out are as follows:

Soil Conditions.—The plants thrive well in light soils, over 500 flower heads were borne on one bush. Heavy soils have not been found suitable inasmuch as the bush does not grow and a large number of plants die in course of time chiefly as a result of slow drainage of rain or irrigation water.

The crop needs well-drained fields preferably with a slight gradient. If there is any waterlogging in any portion of the field owing to local depressions where rain or irrigation water stays on for more than a day or two, all the plants in such portions or fields die as a result of root rot. The germination of seed is highest in September-October. Seed sown before September does not germinate well, whereas seed sown in April also has a fair germination. Before the seed is sown, the seed beds should be prepared a season ahead so that during this interval it could be made free of weeds by repeated interculture. One pound of seed was sown in a bed 20 ft. by 6 ft. The seed may be evenly broadcast on a slightly raised bed and lightly raked after a dressing of half an inch of well decomposed fine leaf mould or sweepings. During the last year, we obtained 15,000 seedlings per lb. of seed which is less than one per 1,000 when sown in the open fields. This year experiments have proved that when matured flowers are harvested individually by selection, we can get about 50 per cent. germination in sheltered seedbeds or trays. So far the seeds have remained viable after two years of storage under ordinary conditions.

Best Planting Season.—In about six to seven weeks the seedlings are fit for planting and those left to over-winter in seedbeds make little growth during the winter season. The best planting season is mid-October to end-November provided bucket irrigation is possible; otherwise planting in early spring after the snowfall or during the spring rains in puddle is advisable. Seedlings can be planted any time during the summer in irrigated lands. Ordinarily in such plantations a large number of seedlings die during this season. Autumn planting will need more than one irrigation. If the spring is dry, one irrigation is essential. Too much irrigation or incessant rains damage the crops considerably. In fact, not a single plant thrives if the land is wet for a considerable period during its active growth. The seedlings should be planted one and a half feet apart in each case. For rapid multiplication the existing one-year-old bush can be sub-divided and planted. By adopting this method one can, on an average, multiply his field ten times. Great care has to be taken against the weeds during the first year of the plantation. Once the plant starts growing and cover the space, all the weeds underneath are checked automatically. It is therefore advisable to conduct all preparatory tillage during the preceding summer season so that all the weeds are brought under control as far as possible. This should be followed by one or two weedings after the planting is done. During the subsequent years, permanent fields will need one weeding and hoeing during the spring season (April-May). If the weather is dry throughout the summer one irrigation will be advantageous.

The harvesting season starts from the beginning of June. For dried flowers, the first flush is ready during middle of June. A second flush of late seasoned flowers appears in the fields sometime in September-October, but the total yield from the bloom does not exceed a few pounds.

Pyrethrin Content.—From the literature it has been observed that there is a quantitative increase in the active principle of the flower head from the small bud stage up to the time of maturity of flowers, more or less keeping pace with the increase in weight of the flowers and rising to a maximum when these come to maturity, that is pollination time. The mean percentage of pyrethrin falls after

this period corresponding with the rapid increase in weight of the head when the seed is formed. This fall in the percentage after pollination is not due to any weakening of the pyrethrin content in the flower head, but to increase in the weight of flowers after pollination without a corresponding increase in the pyrethrin in the flower head. Thus it appears that to obtain the best insecticidal value, the flower should be picked as soon as it is matured, before the formation of the seed. From a field with a fairly good standing crop planted in row 1½ feet apart 300 lb. of dried flowers are obtained during the second year of plantation.

Seed Production.—For seed production, the flowers should be fully mature and they should be retained up to the end of July. Even then, to secure good viability, great care should be taken for selection of mature heads. On enquiry, the Director, Malaria Institute of India, has informed the author that the parts of the flowers remaining after seed extraction and leaves are of no value. However, specimens are being sent for determination of insecticidal properties. Observations on manure are yet incomplete. Preliminary observations have indicated that rich soils produce large-sized bushes with a smaller number of flowers. Soil rich in humus is unsuitable. This was particularly true when the seedlings were planted in spare seedbeds after the removal of seedlings. Such seedbeds are always heavily manured to ensure rapid growth of seedlings. The plant has so far done well as a cover crop in a young growing orchard.

Sample Analysed.—Samples of flowers from the produce of 1939 were analysed by the Malaria Institute of India and the Imperial Agricultural Research Institute, New Delhi. The biological test conducted at the Malaria Institute has proved the product as good and as efficacious as that from Kenya. The pyrethrin contents were .95 per cent. The analysis at the Imperial Agricultural Research Institute found some crystalline substance after extraction not present in the flowers from Kenya or Coonoor. To find out other particulars about these crystals, fresh specimens have been despatched to the Institute as well as to the Rockfeller International Health Division, Coonoor.

In our own entomological laboratory, four gallons of insecticides —mineral oil solutions—were prepared and the product was found efficacious against mosquito adults and aphids. Small samples of five

other varieties, *Pyrethrum roseum, P. Parthenium, P. cineraria, P. carneum, P. leucopiloides,* have also been received from the Imperial Council of Agricultural Research. Out of these, the first two, *viz. P. roseum* and *P. Parthenium,* only have been successful. All the same, these species did not compare well with *P. cineraræfolium.* Samples of these varieties have been sent for biological and chemical tests.

Prospects for Pyrethrum.—His Highness' Government have taken necessary steps for the extension of pyrethrum cultivation in the State. *Pyrethrum cineraræfolium* has been notified as a reserved drug plant, and unauthorised cultivation has been prohibited with a view to maintain the quality of the crop. The Forest Department is utilising all suitable Government land and has taken private land on lease to the extent of about a thousand acres in the first year (1940-41), and necessary steps are being taken for planting this area. Side by side, the Department of Agriculture has also extended its experimental area to over 50 acres in Government gardens. This year, besides producing large quantities of seed, a few maunds of flowers were sold in the market. During the year, about 200 acres are expected to be in the second year of plantation, and within the next two years or so we expected to produce over 300,000 lb. of dried flowers.—*Indian Farming,* Vol. II, No. 8, Dated August, 1941.

Fig. I

FIRE THE SERVANT

Controlled burning in chir (Pinus longifolia) forest

Downhill departmental burning during the cold weather in a regeneration area: Siuni, W. Almora Division.

Photo: F. Robertson.

Fig. II

FIRE THE MASTER

Incendiarism in chir (Pinus longifolia) forest

Twelve years' work wiped out in twelve seconds : Siahidevi, W. Almora Division.

Photo: F. Robertson.

INDIAN FORESTER

FEBRUARY, 1942

FIFTEEN YEARS OF FOREST ADMINISTRATION IN THE UNITED PROVINCES: A SHORT RETROSPECT—I.

BY F-ROBERTSON, I.F.S.

Introduction.—The past fifteen years have seen many notable developments in U. P. forestry. Chief among these are the very great expansion of artificial regeneration, the taking over of canal-bank plantation management from the Irrigation Department, a concerted drive for developing village fodder and fuel preserves in the plains and important progress with our central silvicultural problem—how to regenerate *sal* naturally; on the Utilisation side, the construction of two extremely profitable light railways and the establishment of a complete motor road system throughout the foothill forests; in forest protection, a changeover from the absolute exclusion of fire to controlled cold weather burning; and finally, on the financial side, a record of sustained high annual outturn of practically all classes of produce, yielding a cash surplus exceeding 21 lakhs a year—a higher average, despite the intervening economic depression, than ever before.

FIRE-PROTECTION

In the period under review the area under fire protection has risen from some 3,500 sq miles to over 4,500 sq. miles, the chief extension occurring in the inner hills (Garhwal and Kumaon). Considering the primitive means at the department's disposal, the degree of success has been gratifying, as the following record shows

Quinquennium.		*Percentage of protected area burnt. (average)*
1924/25—28/29	...	Under 2%
1929/30—33/34	...	„ 5%
1934/35 38/39	...	4%

as compared with an average of 7% in the quinquennium 1919/20—23/4. Unfortunate incendiary years were 1931, 1935, and 1939, each with 11 to 12% failures, the coniferous hill tracts suffering most.

An important development in our fire protection policy has been the great expansion of early controlled burning, (*vide plate* 6), particularly in the inflammable *chir* forests, essentially as a measure of fire insurance. Since 1926, a definite tech-

nique has been adopted and developed in all hill divisions, the main features of which are (1) down-hill burning outside regeneration areas on a two or three year cycle (2) "piecemeal" burning in areas under regeneration, *i.e.* round fire-tender groups, combined with running a light downhill fire through all regeneration as soon as the crop averages breast height. In short the only crops completely fire protected nowadays are the very youngest age classes of *chir*. These operations, associated since 1929 with careful slash disposal after fellings have not only lessened the fire hazard for all sizes of tree but have also gone some way to meet the villagers' grazing problem, by reducing the thick blanket of pine needles. No one pretends that the younger *chir* benefit by this regular scorching —it is done lest worse befall: in the hills we are thankful for any working compromise. Analogous protective burning was subsequently applied to the extensive young sal coppice of Dehra Dun Division and to valuable forests of high fire hazard in Pilibhit, Bundelkhand, and other plains divisions—an operation not to be confused with the regular weedgrowth and leaf-layer burning undertaken over large areas of *bhabar* sal as an aid to regeneration.

Under this new régime, protection costs have dropped to about Rs. 15/- per sq. mile with hill areas claiming less than half this amount. Control burning comes cheaper than fire guards whose number has recently been still further reduced by the installation of field telephones in three more plains divisons of high fire hazard.

SILVICULTURE

Noteworthy developments during the past fifteen years have been (a) the enormous expansion of artificial regeneration, chiefly by means of *laungya*, in the *bhabar* and plains forests (b) the reversion of much submontane sal forest to a system of controlled selection fellings, and latterly, (c) the partial solution of the natural regeneration problem in the submontane sal tracts (d) a definite if somewhat tardy recognition of the need for thinnings in young hardwood crops, both natural and in plantations.

The first three of these developments were, of course, interlinked. Neither our valuable submontane sal forests, where we retain, generally speaking, full control over silvicultural factors, nor the extensive miscellaneous forests, where we do not (they being burnt

Fig. I

Sain (Terminalia tomentosa) Taungya

Sown seven monsoons back, thinned at five years when cultivation stopped and grazing admitted : Saharanpur Division.

Photo: H. G. Champion.

Fig. II

Afforestation in the treeless plains

Flourishing *Khair* (*Acacia catechu*) sownation on a favourable site on *usar* waste land : Panchli, Meerut District.

Photo: E. A. Smythies.

and overgrazed every year) had vouchsafed any signs of regenerating naturally, and artificial work in both was being forced upon us. The latter forests were the first to be tackled. All through the latter twenties divisional officers, backed by the Research division, were feeling their way in piecemeal fashion, now with sal sowings ploughed into forest gaps, now with bamboo or teak seed or cuttings, and always with reluctant, fever-stricken rains labour and a sceptical staff: by 1927 *sissu* and *khair* plantations had passed the experimental stage (Haldwani), other species were succeeding and concentrated plantation work was becoming a feature in several important divisions. Meanwhile, away in the east of the province, Gorakhpur division, exploiting the local land hunger, had turned to *taungya* as the best method of regenerating failed sal coppice; as early as 1925 it had successfully sown up 250 acres with sal and on its experience the *taungya* system, sometimes helped by imported cultivators settled into forest villages, spread rapidly westwards, until by 1935 it formed a regular feature in ten divisions from one end of the province to the other. By 1940 the total area being artificially regenerated each year had risen to 4,000 acres—nearly a fivefold increase in a dozen years, the major portion being by *taungya*—with emphasis on plywood and fodder species in non-sal localities (*vide plate* 7).

The process of reverting to Selection working from Conversion to Uniform, essentially a "marking time" measure, was begun in 1932 (Ramnagar division), the respective percentages under these systems transposing from 24 per cent. and 34 per cent. in that year to 36 per cent. and 22 per cent. in 1937-8, since when the significant new head "Conversion to Uniform *mainly by artificial regeneration*" has begun to redress the balance. A further reversion may be expected in the not too distant future as we acquire a surer grasp of the technique for regenerating sal naturally. As a result of intensive research since 1931, involving elaborate experimental lay-outs, control burning, deer-fencing and shrub cutting are now being combined with canopy manipulation to develop whippy reproduction into sapling growth within the period of a single working plan—or less—and it remains only to bring recruitment to the crucial whippy stage to have solved the whole vexing problem, at any rate for the highly important *bhabar* type of sal.

Other changes in silvicultural systems worth passing mention are the steady decline in the area worked under "Simple Improvement" (10 per cent. to 5½ per cent.) and under Coppice with Standards (6 per cent. in 1925 to 2½ per cent. in 1940.)

As regards thinnings, we have advanced all the way from "It is considered that the silvicultural importance of thinnings in sal pole crops has been much exaggerated. The crowns of sal trees have a tendency to thin themselves . . . . "(Annual Progress Report for 1926-7) to "An important administrative development of recent years has been the greater attention and increased intensity of thinnings both in natural crops and in plantations . . . . research and experience have proved that fairly heavy and regular thinnings are essential, particularly with such valuable species as sal, teak, and *sissu* . . . ." eleven years later, and subsequent reports record a substantial increase in revenue, at least half a lakh of rupees annually, from this source, along with a collateral expansion of the subordinate staff, the work necessarily being done departmentally. As more and more additions are made to our youngest age classes under the expanding plantation programme, supplemented, we hope, by increasingly successful natural regeneration work, this side of our silviculture will feature ever more prominently.

AFFORESTATION

After fifteen years of spectacular reclamation work in the hot waste ravine tracts along the Jumna and Chambal rivers, by which time some 16,000 acres had been afforested in twelve districts, the increasing mortality of *babul,* the main species, from *kankar* pan and frost, combined with the high cost of formation and tending compelled the Afforestation division to reorientate its activities. It was being realised that simple closure to grazing without planting a tree could effectively check erosion, create fodder reserves and even restore a measure of natural tree growth; that afforestation in these inhospitable, arid and remote regions had no economic future and that it was time to shift the emphasis of the work to small demonstration plots on more promising classes of waste land such as mild *usar, bhur* and sandy *kholas.* By 1930 such plots had been established in fourteen plains districts and the depression of 1931, with its demand for rigid economy, clinched the matter. Meanwhile, by a most happy

stroke, the Afforestation division was enabled to transfer its hardwon experience from the fierce and uncompromising deserts of Etawah to the promisingly productive oases of the province's canal banks, a heaven-sent transition offering possibilities that have been energetically exploited (these plantations are referred to below). Finally, the division was relieved of the demonstration and propaganda side of its work by the creation in December 1937 of the post of "Forest Development Officer," charged with the duty of forming fuel and fodder plantations in needy plains districts and of utilising the vast extent of barren *usar* lands. This officer, with the combined experience of the territorial, Research, and Afforestation divisions behind him, has in co-operation with the recently formed Rural Development Department already spread his creative activities to 64 villages in eleven districts where forests are quite unknown, has planted over 700 acres of demonstration areas along with numerous instructive fodder fencing plots on *usar* and *bhur*, and has distributed as much as 20,000 plants and 2-300 maunds of selected seed in a single season. It is an uphill struggle against prejudice and age-old apathy but with the bigger landowners becoming increasingly interested in waste land utilisation, a substantial advance in making the plainsman forest and fodder-minded may be looked for.

Another enterprise coming under the category of "afforestation" and worth mentioning because of its high economic promise is the propagation of *baib* grass (*Eulaliopsis binata*). For years on a small experimental basis in the S. Kheri and Silviculture divisions, utilising chiefly firelines and grassy *chaors*, these plantations have proved themselves financially with the growing demand, since 1936, from newly established paper mills in and near the province. Indeed, the earliest plantations of 1930 and 31 have already netted a profit exceeding Rs. 100/- per acre and the work is now being extended in three divisions.

Although not entirely afforestative, for natural growth, e.g., *sissu*, is utilised too, the spectacular development of canal plantation work is most suitably included here. Beginning in 1928 on an experimental basis, with 70 miles of the Lower Ganges canal, the Irrigation department were so impressed with results that further successive transfers of management were effected, until by 1934 the Forest

department was working five plans for 790 miles of canal bank, representing over 14,000 acres of land, with 750 acres being regenerated annually to timber species (chiefly *sissu, khair, jaman* and *tun*), fuel (chiefly *babul, khair,* and *mulberry*), bamboo, fodder grasses and fruit, according as the varied soil conditions indicate. Annual profits exceeding Rs. 60,000 have already been shared with the Irrigation department, thinnings of the rapidly growing new crops are three-yearly and with the forest management of the remaining canal systems of the province transferred to our control in 1940, which has raised the total area to 27,000 acres along 1,200 miles of canal, this department is firmly launched on a highly remunerative profit-sharing enterprise with the Irrigation authorities in the heart of the tree-hungry plains. These canals in future will have forest wealth to sell as well as water, and as their green leafy fingers extend far and wide through the dry *moffussil* (interior) they may well become successful ambassadors for a forest policy and programme there.

Finally, a specialised enterprise of the past 10 years deserving of brief mention is the introduction and eventual establishing on a commercial scale in the Garhwal highlands of the valuable *kuth* plant, *Saussurea lappa,* whose aromatic root has for centuries been highly prized for incense. Indigenous in Kashmir above 8—10,000 feet, a few precious seeds smuggled out in 1930 formed the basis of now flourishng and extensive nurseries sited along the upper tree limit of birch and fir in the *bugials* of Garhwal. The whole technique of intensive propagation has been fully worked out, growth has generally surpassed the best Kashmir standards and the first batch of dried root came on the market in 1939. Carriage costs from these remote uplands rule high, but provided a reasonable price can be maintained under war conditions (the essential oil has also a medicinal value) this small localised industry should play a useful part in the economy of these barren, needy regions.

WORKING PLANS.

Apart from the reversion to Selection fellings mentioned under Silviculture, which is expected to be only a temporary phase, there is little to record under this head beyond the regular revision and improvement of working plans according to a definite programme.

These plans cover more than 99 per cent. of the area under the control of the department and are nowadays framed to run for ten or fifteen years according to the intensity of working prescribed. A comparison between the latest plan for the Dehra Dun Division (starting in October 1941) and Mr. Bhola's of 1923-4 to 1932-3 gives a good idea of how work has intensified in the past fifteen years.

UTILIZATION

The most noteworthy items under this head are—

1. *Forest tramways.*—Two highly successful tramways or, more properly, light railways have been running, one in Haldwani division, sixteen miles in length, from 1924, and the other in Gorakhpur division, fifteen miles in length, from 1926. By 1933-4 these had recovered their capital cost of $5\frac{1}{4}$ lakhs and all maintenance charges, plus a $2\frac{1}{4}$ lakhs profit. In 1940 that profit had increased to $12\frac{1}{2}$ lakhs, equivalent to a 217 per cent. return on the money invested—a record the best railroad companies must envy; and both lines are still in full running. Moreover, by keeping down cartage costs during a period of intensified working, these tramways have also brought us increased timber revenue.

2. *The Resin Industry.*—This departmental enterprise has continued to flourish, with an annual output varying between 48,000 and 112,000 maunds of resin and, through improved methods and supervision, a greatly increased yield per 100 channels tapped—as high as 8 maunds per cent. The industry now occupies a key position in the economic life of the hill people who labour for it, paying several lakhs of rupees in wages each year—the major part of their revenue assessment—and earning a gross annual revenue for the department of nearly five lakhs of rupees, exclusive of profits shared from the Resin Company's trading.

3. *Railway Sleeper Supplies.*—The department has maintained its arrangements for passing sleepers departmentally to the various railway purchasing groups from the annual timber coupes, both in sal and *chir* forest, with satisfactory results to all concerned. The annual turn-over has varied considerably, partly because railway requirements fluctuate, partly since certain railways prefer at times to pass and purchase their sleepers direct from contractors. The peak year was 1929-30, when sleepers to the value of over 21 lakhs of rupees

and covering every size from Narrow Gauge to B.G. bridge-and-crossing were passed to the various railways; this figure declined to 8 lakhs in 1932-3 and under 6 lakhs in 1933-4 but has since risen again to a steady 7 or 8 lakhs per year. A substantial proportion of this is in the form of *chir* B.Gs. from the Kumaon hills which provide a major percentage of railway coniferous requirements in India.

COMMUNICATIONS AND BUILDINGS

The outstanding development of the past fifteen years has been the creation of a separate system of *kachha* roads for light motor traffic throughout the *bhabar* divisions, so that it is now possible—and a most pleasurable experience—to drive right through from the Jumna at Kulhal eastwards to the Sarda river, a distance of 234 miles, and thence *via* the Banbasa canal roads to Pilibhit and other divisions of the Eastern circle. This network of motor roads, now virtually complete, which with all its branches totals over 300 miles, has revolutionised touring for busy inspecting officers and largely transformed the subordinate staff from a mounted to a cyclist corps; while the *shikari* or at any rate the poacher has had his hunting made all too easy. It has also necessarily retarded the extension and improvement of our all-important lines of export but a five year programme is now being planned to fit the main cart roads for lorry traffic. During this same period the plains divisions have added 200 miles to their already extensive motor road system, which now totals nearly 1,000 miles.

Few rest houses have been built during the period except in the mountainous wilds of East Almora, where a severe climate and the absence of motorable and, indeed, any roads renders a full complement desirable; the major part of the money available has been devoted to re-housing the subordinate staff and although much remains to be done, particularly in the plains divisions, the standard of accommodation and water supply has improved out of all knowledge.

As the following quinquennial figures show, the department has been progressively pinched for money under both communications and buildings in the past fifteen years; as these have increased in mileage and number, provision for their maintenance has dwindled, a state of affairs that cannot continue indefinitely.

Quinquennium.	Roads.				Buildings.		
	New works.	Length (miles)	Repairs.	Length (miles)	New works.	Repairs.	Remarks.
1924/25-28/29.	37,233	154	1,58,057	6,394	93,711	1,13,218	All figures are the average per annum.
1929/30-33/34.	13,710	91	1,18,588	6,731	51,393	92,770	
1934/35-38/39.	10,333	77	98,679	6,886	39,273	93,246	

NOTE :—Expenditure on tramways is not included here.

YIELD AND REVENUE.

The average annual yields for the past three quinquennia show that our forests have maintained an extraordinarily high level of productivity—

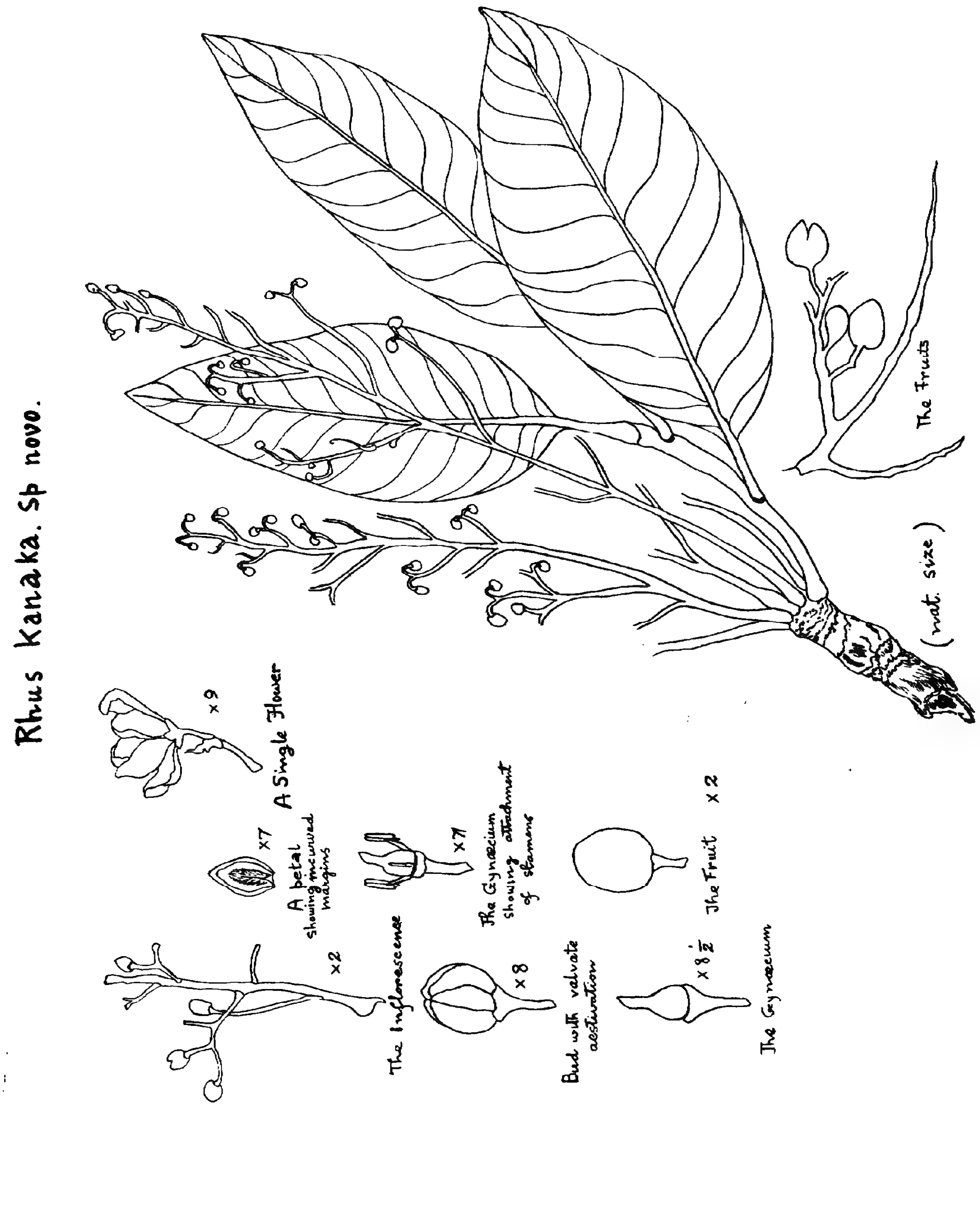
Quinquennium.	Timber cu. ft.	Fuel cu. ft.	Bamboos. nos.	Grazing & Fodder Grass (rupees).	Other minor Forest Produce (includes resin).
1924/25-28/29.	9,929,000	25,732,000	19,762,000	526,000	973,000
1929/30-33/34.	8,412,000	23,140,000	18,040,000	606,000	848,000
1934/35-38/39.	9,762,000	31,136,000	19,907,000	670,000	872,000

Of the timber outturn, roughly 75 per cent. consists of hardwoods and most of that is sal, with *sain* a poor second. During the economic slump that started in 1930, which affected the timber market badly for some years, the demand for sal, the mainstay of our revenue, hardly faltered. Its pre-eminent position seems unassailable. Of other species, *semal* spurted from 1937 under match factory demands, while *sissu* outturn has declined, chiefly because the stock of high diameter trees needs conserving. Since 1934 fuel exports have soared with the growth of the U.P. sugar industry but less than half of the total provincial outturn is actually purchased; the majority goes to right holders and concessionists, chiefly in the hill tracts. The bamboo outturn (it includes the hill *ringals*) has remained fairly

stable but the quality and size are said to be declining. A drop in grazing revenue, due to the Congress Government reducing or abolishing fees with a lavish hand, has been more than offset by the rising demand for grass for paper making; while the value of minor forest products, of which resin forms much the most important item has maintained a satisfactory level. All in all, the U.P., with a sustained annual outturn of some 8,000 cubic feet of timber and fuel from every sq. mile of forest, attains a level of productivity probably unmatched by any other province.

As might be expected from the above outturn figures, the financial position of the forests has become better than ever before. The boom quinquennium commencing 1924-25 yielded an average annual surplus of nearly 29½ lakhs of rupees while the two succeeding quinquennia, despite the prolonged economic depression, averaged 21 and 21½ lakhs respectively, figures over 2 lakhs higher than the best showing of any previous period. This is no mean achievement for a forest estate of some 5,000 square miles, saddled with rights to the annual value of 17 lakhs of rupees. The Chief Conservator of Forests in his last report (A.P.R. for 1939-40) writes confidently about the future "...........the signs are definitely promising. Despite the loss to the Forest Department of grazing revenue, a loss which is the people's gain, other factors are very favourable, for example, a market which absorbs all we have to sell and asks for more, the regular revision of working plans which often enables us to fell and sell more, more intensive silviculture and the great development of plantations. Barring another great slump or unforeseen adverse development, these and other factors suggest that the annual gross forest revenue should not again drop below the half crore level and an annual surplus of Rs. 20 to Rs. 25 lakhs should be attainable."

(To be concluded.)


Rhus Kanaka. Sp novo.
A Single Flower ×9
A petal showing incurved margins ×7
The Inflorescence ×2
The Gynaecium showing attachment of stamens ×7
Bud with valvate aestivation ×8
The Fruit ×2
The Gynaecium ×8½
The Fruits
(nat. size)

RHUS KANAKA, R. N. DE. *SP. NOVO.*

BY R. N. DE, I.F.S.

A small tree, with thin, light-brown bark, exfoliating in papery flakes. Blaze of light fleshy colour, with white vertical streaks. Freshly-cut surface exudes sticky, acrid juice. Leaves clustered at the ends of branches, simple, alternate or sub-opposite, exstipulate, glabrous, somewhat thick, 13 to 24 centimetre long, 6 to 12 centimetre wide, elliptic, or elliptic-obovate; base acute or obtuse, often slightly lobed; lamina articulated at the base; apex acute or short acuminate. Petiole 1.5 to 4.5 centimetre; upper surface; of the midrib light pink in younger leaves. Veins prominent, 10—16 pairs, intramarginal.

Inflorescence—a many-flowered panicle, puberulous. Flowers small, white, turning brown if slightly crushed. Calyx 5-lobed; corolla 5, valvate; lobes lanceolate, edges of the petals folded inwards; stamens 10; anthers extorse, 2-celled, opening by sutures; style short, thick; stigma obliquely truncated. Ovary one-celled; ovule one, pendulous. Fruit a drupe. Green fruits smell like young mangoes.

KHASI & JAINTIA HILLS —Barpani. Sriram Sarma, Sheet No. 18452. Type sheet in the Assam Forest Herbarium, Shillong. *R. kanaka* R. N. De, species nova, *R. cotino* Linn affinis, sed ab ea foliorum laminis glabris valde majoribus, petiolo breviore, lamina basi petiolo articulata, folii apice acuto vel acuminato et inflorescentiæ pedicellis omnibus flores gerentibus recedit.

This specimen could not be matched either at Kew or Sibpur. It differs from *Rhus continus* Linn., the only other species in India with simple leaf, in having much larger leaf-blades with a shorter petiolo, glabrous leaves with an articulation at the base of the lamina and leaf apex acute to short acuminate. Its inflorescence also has no flowerless pedicels.

I am much indebted to Dr. S. K. Mukherjee, Curator of the Herbarium at Sibpur, for much help while working with the specimens and to Professor Sally Meyer of the Bethune College, Calcutta, for drawing the diagram (plate 8.)

A NOTE ON THE PARLAKIMIDI FOREST DIVISION

BY RAI SAHIB A. L. BANERJEE.

Short History.—The present Parlakimidi Forest Division consists of Parlakimidi and Thumba Maliahs, forming a portion of the Eastern Ghats in the agency tract. It comprises of very steep hills of elevation ranging from 1,000 to 5,000 feet above sea level, with a few broad and narrow valleys in between them. The management of Parlakimidi Maliahs passed through the *Zamindar* (landlord) and the Court of Wards between 1860 to 1880 when a friction arose between the Bissoi of Guma and the Maharaja regarding the ownership as it was revealed that in about 1800 the agency tract was cut off from the *Zamindāry,* (private ownership) the Government claimed the ownership. In 1900 the Privy Council decided the ownership in favour of the Government.

Thumba Maliah forest being part of Jalantra estate was forfeited to Government due to bad debts by the Raja of Vizianagram.

Area.—The area of Parlakimidi and Thumba Maliahs including village sites and cultivated fields is 372 square miles only, within the agency tract.

Soil.—The soil varies from black cotton soil with an admixture of lime to stiff clay in valleys and plateaux, to sandy loam at the hill slopes mixed with various sizes of bolders to compact mass of rocks. The richly manured soil which originally covered most of the rocks has been washed away by repeated shifting cultivation, resulting in bare rocks projecting above the surface of almost all hill slopes and tops.

Rainfall.—In 1854 the rainfall was reported to be between 80 to 90 inches yearly, due to the existence of forest covered hills, whereas the rainfall had decreased to 48.64 inches in 1900, by which time most of the forest vegetation was cleared away. In 1834 the Maliah tract was reported to abound in springs of fine clear water, whereas now only a few of the streams are perennial and others flow only after heavy showers.

Population.—The agency tract is divided into 10 "muttas." In the mutta headquarters, or, forts as they are called, for controlling the savaras raiding and looting in plains, with a few *paiks* and *Hodadars*

as his force, lives the Bissoi. The savaras used to live close to mutta headquarters, but were gradually driven up the hills due partly to the lower hill slopes becoming sterile and unfit for shifting cultivation and partly to the wet land having been taken away by *Panos* who came from somewhere else, about 100 years back and resided in mutta headquarters, near *paiks* for loans.

The population of the whole of the agency tract is not available. The following figures compare the population of some of the villages in 1871, 1891, and 1901, *viz*:—

1871	Savaras	17,461;	Hindus	2,002
1891	..	25,438;	,,	4,521
1901	..	28,911;	,,	4,884

It is difficult to say whether the above increase was due to the increased birth rate or to the infiltering of the savaras from the plains. Similarly, the population of Hindus was increased by the intrusion of the *Panos*. In 1871 it was reported that the scanty population of savaras above the ghats, used to clear little plots for toila cultivation whereas now the savara villages, consisting of a collection of hamlets, spread over the whole area of the hills.

Principal Forest Species.—Sal, piasal and *tangani* are the principal species with the usual associates of *kosi, sidha, suam, dhow, asan, hollando* and other deciduous species, either growing scattered or in small groups. The existence of isolated *sal* trees of 6 feet in girth and *piasal* trees of 15 feet in girth and the *champa, semul* and *jammu* trees of 10 feet or more in girth gives evidence of the luxuriant *sal* forests in the past.

Kanta and *salia* bamboos also occur in hills. The *salia* bamboos are mostly dead after seeding in recent years.

At the tops of Singaraj, Devagiri and Mahendra hills there is no growth except grasses and wild date palm bushes and a few *Windlandia* species of stunted growth.

Under the management of the Court of Wards and later on of the *zamindar*, valuable timber trees were exported, apparently from the low lying lands up to where the carts could go, resulting in the growth of dense thorny jungles on the opened patches. In 1858 it was necessary to bring the land on both sides of the roads under cultivation to keep them open. With the emigration of the savaras

from the plains and valleys the once famous forests of Parlakimidi Division had disappeared due to shifting cultivation and indiscriminate revenue fellings.

Communications.—Ungraded agency roads have been constructed to pass through mutta headquarters and maintained by the Revenue Department. Except up to the border of the agency tract adjoining the state, nowhere within the tract is cartable. One must have to walk for touring inside the agency.

Game.—In forests close to the adjoining estate *viz*: Gumma and Thumba muttas, occasional tigers, and leopards, barking and spotted deer, wild pigs, peafowls, fowls and green pigeons are seen. Black bears are found everywhere.

Habits of the Savaras.—The savaras are very hardy people, though lazy. When they found that their lands for shifting cultivation were becoming barren, they made terraced fields, by cutting hill slopes and building retaining walls of loose stones packed at the lower edges, in which they grow *mandia* and paddy also. But for the loss of *humus* on the forests above due to repeated cutting and burning for toila cultivating, these terraces also became barren in the course of a few years. Only the ash obtained by burning the debris which is utilised as manure also is not available in many places, as the stumps of the trees due to repeated cuttings failed to produce shoots. Then they shifted to some other part of the forests and resided there until the soil there also became sterile. On the hill slopes—the steeper the better—*jhona, ghantia, kandulo,* and other varieties of crops are grown together. They prefer shifting cultivation to wet or dry cultivation as two or three showers of rain are enough for the hill crops to ripen, whereas wet or dry crops depend entirely on rains.

Their daily needs are very few and their clothing very scanty. With a small quantity of salt and chillies they can manage their meals. They take meat of even poisonous snakes after throwing away the hood. Usually fire keeps them warm in winter. Both men and women use same sort of beads as necklace if they can afford to purchase.

For each new crop they arrange a festival before using it. During these festivals they are required to sacrifice goats, pigs or buffaloes in large numbers and some sort of intoxication—*Solopo, Mohulo* or

date palm juice is essential—for dancing the whole day and night and for several days on each occasion. They do not use any medicine—Allopathic, Homœopathic, or Ayurvedic. When a savara gets ill, he uses the roots of trees and shrubs known to him. With the seriousness of the disease they take to sacrificing—starting from a fowl to a goat, a pig, and lastly buffaloes which may be one or more depending upon the financial circumstances of the family. When they find that the patient is not recovering and give up all hope, they begin firing guns every half-an-hour or 15 minutes. Hearing this the savaras from remoter places come to the spot—some of them also firing. Perhaps the poor patient dies in the meantime of heart-failure, as on hearing the gunfire he thinks he must die. Their idea of gun firing is that with the sound of gunfire the soul of the deceased goes to Heaven. After the death of the patient drinking and sacrificing buffaloes must again be taken up. None must cry for the deceased.

They do not bathe daily. Usually when they come to the markets, they take a bath in the streams on the way. They do not drink much of the fresh water and hence do not care if water is far away from their houses. Some savara families living at the top of a hill carry water from its foot, in hot weather.

They believe in and obey their leaders, who are called *Gomangos* or *Bhuyyas* and are, perhaps, hereditary and recognised by Government. Although there is great unity among them, murder and quarrel are not infrequent.

Education.—Although there are many Elementary schools throughout the agency tract, the savaras, except a few, do not care to attend the school. In some places they have burnt school houses.

Relation between the Bissoi and Savara.—The *Bissoi,* as the head of all the savara villages in the mutta, has the Pesinia, Jagua *Paiks,* and Kata *Paiks* under his command. For each village there is one Pesinia or more depending upon the extent of the village. Pesinias' duty is to carry orders from the Bissoi to the savara heads and to bring any information relating to the village to the Bissoi. In fact, the savaras would not come to any work unless the Pesinia of the village calls them. *Jagua Paiko* watches the camps of officers touring during day and night in turn. Kata Paiks carry *dak* to and from Parlakimidi,

These paiks and pesinias have *inam* lands. In addition the savaras pay *mamuls* in shape of money, kind and labour to the Bissoi, Paiks, and Pesinias, as fixed by Government from time to time. With the aid of these Paiks, the Bissoi is supposed to keep the savaras under check against raiding the plains.

Relation between the Panos and Savaras.—It is not known since when the *panos* and other *mahajans* came in contact with the savaras. Perhaps when the savaras were living in plains or on hill slopes close to the plains, there were but a few *mahajans*, who managed to take away the wet fields of the savaras for the loans. The savaras were compelled to go to the top of the hills for shifting cultivation. The *panos* and other *mahajans* came in and resided in the mutta headquarters. These men take salt, chillies, tobacco leaves, dry fish to the savara doors and exchange with savara crops viz: *jhon, ghantia, kandulo,* etc. The *panos* specially supply buffaloes to the savaras during their festival times or for curing their diseases as mentioned above. Very often the savaras cannot pay for the purchase in money or in kind readily and the sale price thereof becomes a loan. The loan plus interest and the wages of the *pano* who carries the commodities, is realised by the *mahajans* after one year during the harvest season. In this way the savaras have to pay one-and-a-half to three times the market price even if these *mahajans* deal honestly, *e.g.* for one rupee worth of produce at market rates they are to pay Rs. 2-10-0 and in case of buffaloes for a Rs. 9/- worth of buffalo Rs. 13-8-0 is to be paid excluding the skin and horns which are to be given free to the *panos* for timely supply.

The sacrifice of buffaloes in a year is not small. It was estimated that about 2,000 buffaloes are sacrificed per *mutta* per year. Thus 20,000 buffaloes are sacrificed in the whole *Maliah* each year. The savaras therefore lose Rs. 90,000 each year and when the value of skins and horns is added they lose much more, from the purchase of buffaloes alone. When other commodities are added the loss must be more than one lakh. This needed the demand of more lands for shifting cultivation. If the savaras begin to purchase their needs and sell their crops themselves in the market they can save a lot of money annually.

By the end of 1940 it is said that somebody explained to them that they were being cheated by the *panos*. The savaras combined, burnt and looted many *panos'* houses until the police controlled them.

Forests and the Savaras.—When the savara clearances threatened the denudation of forests in the agency hills, suggestion for conservation of forests started in 1876. In 1901 certain executive rules were framed to preserve the remnants of the Maliah forests. Under these rules the savaras can toila-cultivate in the unreserves for which they are not required to pay any *mamul,* but in reality the *mamuls* in kind are paid from the crop of these toila lands. Between 1908 and 1916, 127 square miles of forests over the tops of hills were reserved under Section 26 of Madras Forest Act out of which in 1922 and subsequent years 24 square miles were disforested on account of the savara *fitoar* (disturbances) leaving at present 103 square miles of reserved forest. While reserving, the policy of the line of least resistance was adopted and consequently the densely populated area contained less area of reserves and thinly populated areas contained more. In a few years time unreserves in both densely and thinly populated areas were denuded by repeated cutting and burning the growths for toila cultivation.

Occasionally some of the savaras had clear felled small portions of the reserves for toila cultivation and they were convicted in court. The officers sympathised with them and allowed them to cultivate the cleared lands after returning from jail. Such areas were not disforested. Thus the savaras formed an idea that once they suffered imprisonment for clearing a portion of the reserves, that area becomes their own property. With the increase of loan and perhaps of population the demand for land for toila cultivation increased and the savaras put in petitions for releasing reserves for toila cultivation. Attempts were made to relieve the congestion by State-aided immigration to tea gardens. But after returning from the tea gardens the same congestion occurred. *Taungya* cultivation was also tried but it was found that the savaras did not care to tend the forest crop. The forest species failed in those areas due to the carelessness on the part of the savaras and to the thick tall growth of the field crop. Since 1936 some savara village or other started clear-felling vast areas

in the reserves and they were prepared for any penalty. They were sent up and convicted. While the men were in jail the female members continued the cultivation. After returning from jail the savaras cleared the area again for the next year's crop. Investigation was also made to allow *taungya* cultivation in the reserves on a rotational basis and to preserve the denuded unreserves for allowing controlled toila therein in future. Some savaras accepted this scheme while others did not. They did not want to part with the unreserves though yielding nothing. But it was found that the area of the reserves was not sufficient to allow all the savara population to *taungya* cultivate in a rotation of 30 years. Fifteen coupes were suggested to be made, each coupe being allowed to be cultivated for 2 years. So that was abandoned. The Partially Excluded Areas Enquiry Committee appointed by the Government, suggested to put down toila cultivation and to reserve more hill tops by removing some of the savaras to Jeypur estate where vast areas of unreserves were supposed to exist. It also suggested *chenchu* shops to be opened by Government in order to supply the savaras their daily necessities at cheaper rates. These suggestions are under investigation. There are already shops at each mutta and the savaras do not generally care to purchase their requirements from these shops—especially because they cannot pay up readily and their need for sacrifice cannot be supplied by anybody except the *panos*. In Jeypur estate also some savaras (near Berthamguda) have already taken to illicit fellings in the reserves and are ready for any penalty. Some consider that the prescription of one month's imprisonment is not sufficient to prevent the savaras from such activities but the savaras expressed that they were happy in jail, except for want of liquor. Some consider that the conservation of these forests is not to the benefit of the savaras if they are to be removed from their ancestral land. The object of preserving the hill tops is mainly the prevention of erosion and permanent supply of water through the streams rising within the tract for cultivation and other purposes both in the Agency and in the plains.

The savaras are the only labour available within the agency tract. They do not work on daily labour, as they take their own time to come to and go away from any work. When they are required

for any work, one man from each house of a village comes forward. Whatever payment is made (usually the estimated cost), they either distribute among themselves or arrange a feast. In some muttas some of the savaras are now refusing to work.

Government Forest and Plains people.—The villages adjacent to the agency boundary encroach upon the agency reserves in gangs and steal away fuel and timber for their daily needs and also for sale, as the hills in plains are also denuded. Forest staff in small numbers cannot put this down. When a gang of savara smugglers finds the forest force more in number (they can see from the top of the hill—the lower area being almost blank), they run away uphill; but when they find the forest force less in number, they assault if interfered with. Consequently the forest staff and the *paiks* who come for help run away and are afraid of patrolling the area. The police station under whose jurisdiction the area lies is more than 20 miles from the place uphill. So local police help is out of question. The Forest Department cannot employ more staff as financially this division is poor. The average annual revenue is Rs. 30,752/- and expenditure Rs. 29,240/-.

Each division should be self-supporting—specially when there is no certainty of the existence of these forests as at any time the savaras may clear-fell any area.

Management of Forests.—The accessible areas close to the estate are placed under coppice with standards working circle with a rotation of 30 years. Bamboos occurring in these accessible areas are being worked in a 3-year rotation.

Any surplus *sal* logs which the savaras do not require are exploited. Similarly *piasal* trees are converted into cartset materials and extracted by the savaras on their shoulders and sold departmentally.

The main revenue of this division comes from minor forest produce, specially tamarind. There are many old tamarind trees in the unreserves and village sites. When these will die or will not yield any fruit after about 30 to 40 years, the revenue of this division will fall unless tamarind plantations are raised. But will the Forest Department depend on minor forest produce in this division?

Experiments are being made in raising teak, *sandal*, red sanders, gambar, tagini, and *piasal* timber trees but the result is not encouraging due mostly to the poor soil, and partly to the uncertainty of the attitude of the savaras who may clear-fell any area including the plantation at any time.

What can be done.—So the problem of what can be done is difficult to solve in:

1. Putting down shifting cultivation by the savaras.
2. Giving the savaras their immediate want.
3. Protecting the savaras from the clutches of the *panos* and the *mahajans*.
4. Protecting the *panos* many of whom depend entirely on the trade with the savaras.
5. Educating the savaras economically.
6. Protecting the Maliah forests close to the estate boundary.

PUNJAB AND COLONIZATION

By P. N. Deogun.

The greatest problem for a prosperous country is not only to find an outlet for its goods but for its growing population. World's wars have been and are being fought on that account. War means destruction and usurpation of property, destruction and enslavement of life and a change in the old order.

Some years ago this very problem faced the Punjab. The Punjab under the British rule had the first care-free and peaceful time after generations of unsettled life. It became prosperous and its population increased. It could not provide for this increased population. The more enterprising dashed out to any place outside the Punjab, to China, Hong-Kong, Shanghai, Japan, Australia, Newzealand, Africa, America or any place under the Sun. Some were lucky, others sorry, but this did not exhaust the Punjab's surplus.

The same Government which had brought prosperity and the consequent increase in population came to its rescue and led one ol the biggest campaigns known to history. No pains were spared and millions were spent to help the Punjab and Punjabees and the world in general. The engineers who formed the vanguard took little time in conquering and enslaving the rivers. Once this was done and it was known that cutting down the old *rakh* and scrub trees will mean more cultivation and prosperity, armies of Punjabees fell on to them and in a short time turned the old jungle into fields, which not only yielded the much-sought-after 'board and lodging' but enough of gold to buy luxuries. The old *rakhs* and scrub jungle which had provided the province firewood, small timber, grass, grazing, minor forest products, afforded shelter to game birds and animals and above all controlled the climate and kept back the advancing sands through storms, were removed in no time.

Cowdung replaced the fuel wood, fodder crops, the grass and grazing but for small timber the colonizer has to look to some straight tree in his or anyone else's field or on canal bank or road-side for stealing or getting otherwise. The villager must have his *hal* (plough for cultivation), *karah* (scroop for moving earth to level up fields), *sohaga* (clod-breaker), *jandra* (fork for watbandi, etc.), *dandal* (harrow), *mungali* (wooden hammers), *jula* or *panjali* (yoke), *kunda* (rake for collecting wheat and grams), *trangal* (rake for sorting out grains from straw), *phalla* (for thrashing wheat), *chak* (well curb), *gadda* (bullock-cart), *rahat* or *halt* (persian wheel), *kharas* (flour mill), *belna* (for crushing sugarcane and for ginning cotton), *bhouni* (windlass for drawing water from wells), *prani* (driving stick), *khurli* (manger—movable and fixed), *ukhli* and *mohla* (for husking rice or crushing articles for daily use), *charkha* (spinning wheel), *madhani* and *kur* (for churning milk), *vehangi* and *vahna*, etc. (for carrying materials), *pirhi* and *pirha* (low chair), *gharwanji* (stand for pitchers), *charpai* (cot), *panghura* and *palki* (craddle and palanquin), *chakla belna* (for rolling chapaties), *dahmni* and *patra* (for washing clothes), tool handles, house timber, *viz.* rafters, *karries*, window and door frames and leaves, etc., shelves, almirahas, boxes, furniture like table and chairs, thatches for cattle, baskets and above all his *mugdar* and *mungli* (Indian clubs) to keep fit and

smiling. If the villager has to go over miles and pay heavy prices for them he will curse himself and his forefathers for cutting down and for not planting up old *rakhs*.

Some of the above requirements may be provided by town manufacturer from timber from hills at a cost which the poor villager may not be able to pay; but can any civilized people permit of the use of cowdung for burning instead of using it as manure, especially in a country where chemical manures are practically unknown?

Will it not be better to save labour and water spent on fodder crops and provide grass and grazing at nominal rates? Have these fodder crops helped in fodder famine years? If there were tree areas with grass they would certainly help in tiding over the famine years.

So the question of colonization of old *rakhs* and scrub jungle which extended over hundreds and thousands of miles does not end there. The Government has to replace a part of that area with some better crops not only to provide for the bona-fide every-day requirements of the surrounding population but to maintain and if possible to improve the climate of the country and to check the duststorms and advancing sands. The Government has done something and there are a number of irrigated plantations in the Punjab. What is wanted is more of these scattered over the Province, especially in the dry districts of Multan, Montgomery, Rohtak, Hissar and Lyallpur, etc.

The requirements for the creation of irrigated plantations are few, viz. land, water and finance.

LAND

There is no dearth of land and if the requisite quantity of water were available the cultivation figures will go up considerably.

WATER

Water is the greatest handicap or at least it appears to be so in the creation of plantations. This is because the question has generally been examined cursorily and not in detail. As a matter of

fact whatever water is given to a plantation is paid back to cultivation. It is common knowledge that cultivators in the vicinity of a plantation mostly depend for the feed and up-keep of their cattle on the grass and grazing provided by the plantation and they do not sow half as much of the area under fodder crops as they have to in the absence of a plantation. Water saved from the fodder crops is utilized by them for growing cotton and wheat for which not only the Government gets higher water rates but this brings more revenue to the cultivator and contributes to the general prosperity of the province. Plantations are given *kharif* supplies only, but they help in saving both *kharif* and *rabbi* supplies to the cultivator. Again the fodder raised by the forest Department on behalf of the cultivators has a greater value than their own fodder crops. It is available at all times to a greater or smaller extent and can help in tiding over fodder famine years.

These plantations effect a saving in water for the zamindars in another way, *i.e.* by saving him manure. Manured fields need less water and conserve it for a longer period than unmanured ones. The small firewood which is sold to the surrounding population at nominal rates (Rs. 1/- per 30 or 31 headloads), helps in saving tons of cowdung from being burnt which goes to the field where it not only helps in saving water but in producing better yield. This cheap wood helps a cultivator to bake bricks, and pots, sink wells and rig them up with material, *viz.* ropes, wooden structures, etc., obtained from plantations thereby augmenting the canal supplies and helping in increased cultivation.

These are the indirect benefits, by no means small and negligible to the surrounding population. It will be seen that plantations are not a drag on the Irrigation Department but are an asset. Only *kharif* supplies are taken and experiments are in hand to dispense with most of the water in the period of keen demand, *viz.* sowing and maturing season of cotton and wheat. Results obtained so far show that it is possible.

FINANCE

No work can be done without money. Every scheme has to be financed. The only question is to see if the investment is sound or

not. There is no doubt that money is locked up for a number of years but it appreciates and not only brings in a good return but is of help to the nation. Chhangamanga plantation is an example. It was started in 1866. By 1913-14 repaid all its capital cost to the Government together with 4 per cent. compound interest and now produces a net surplus of Rs. 20/- to Rs. 25/- per acre per annum. This shows that even in competition with farm crops wood is a paying proposition. It is not the work of an individual who generally has his immediate future in view, but it is for the State to look to the wants of its people and to arrange for them.

A few other advantages of plantations are noted below—

UNEMPLOYMENT AND CRIME

These plantations give employment to hundreds of thousands of persons. There are persons working directly in the plantations generally belonging to classes which would otherwise take to crime and would become a source of danger to the province. There are those who plant, weed, thin, fell, stack and carry the firewood; those who do earth work and look after the irrigation, and the maintenance of plantation generally; those who buy and sell the wood; those who utilize it, the furniture maker, the carpenter and the sports goods manufacturer; and those who get employment from the above, *viz.* the suppliers of paint and polish for furniture and sports goods, leather for upholstery and hockey sticks, gut for rackets, and so many other small articles used; the printers of advertisements, the selling agents, the shop keepers, etc. etc. Each acre of a plantation which is fully formed can support, on a rough estimate, more than 50 souls which is not possible for the same area under cultivation.

CLIMATE

These plantations tone down the severity of climate and if scattered all over the dry districts they will reduce the severity of duststorms and dry and desiccating winds, thereby checking any advancing sands; and help in the improvement of the climate generally. These are little oases in the desert as can best be realized on a summer day when approaching a plantation. The trees act as force pumps. They bring water from the sub-soil and throw it up in the air. A hot and dry wind passing through a plantation loses its sting (*vide* plate 9).

WHAT IT WAS ?

A Scrub Forest
With *Salvadora*, *Capparis*, *Prosopis* and *Tamasix* species.

WHAT IT CAN BE ?

An Irrigated Plantation
With *Sissu* trees, 11 years old, forming the upper storey and mulberry nursery, 6 months old grown under a new technique developed by the author seen in the picture.

FUEL RESERVES

The surplus firewood after meeting the demand of villages can be sent to the towns whose population has also to be provided for with its necessities of life by the Government. Wood cannot be replaced as a source of heat. A poor worker who earns about 5 to 6 annas a day cannot afford anything else but a pice worth of fuel which he chops up in small splinters and uses frugally to cook his *dal-roti*. Majority of the town population cannot afford electricity or any such thing. It cannot even pay the rent of the meter what to say of various appliances required for electric heating, etc.

In addition to the supply of small timber as noted above these plantations provide big timber for furniture, for lorry bodies, for trains, for floors, for house buildings, for sports goods and for various other articles of daily use.

Plantations can be of two types—those for the benefit of the villager and the countryside and those for the town people to be run on commercial lines. The former can be about 1,000 to 2,000 acres and the latter 7,000 to 10,000 acres in area.

These commercial plantations can be made in areas with a better rainfall and high subsoil water, on water-logged soils which have become useless for field crops, along river banks, at the head of canals, or such places in order to reduce the quantity of irrigation water and thereby the production costs.

SPORTS INDUSTRY AND PUBLIC HEALTH

The present sports industry is solely dependent upon one of the plantations. Sialkot has become famous for its sports goods. Hockey sticks are produced so cheaply, as to find a sale in the poorest of the families. A Punjabi child's first toy is a hockey stick. This provides for the growth of a healthy nation. India not only won the Olympic Laurels in the game of hockey some years ago but has held its first place ever since. Thanks to Chhangamanga plantation and that great Captain of Punjab Industry, S. Ganda Singh Oberoi, who introduced mulberry for hockey sticks which is 25 per cent. stronger than English ash and several hunded per cent. cheaper.

COTTAGE INDUSTRIES

A large number of small cottage industries like making of baskets, ropes, wooden slippers, flutes, tool handles, bed posts, toys, agricultural implements, musical instruments, etc., can be started. But the most important of all are Bee keeping and Silk.

Bee culture requires very little capital. It only requires demonstration. There are large numbers of plants which are in flower for most of the year. *Prosopis glandulosa* which is the main honey plant of Texas, is in abundance and all these can be exploited for Bee culture.

SILK INDUSTRY

Silk worms can be reared near these plantations under artificial climatic conditions which modern science can provide. There is enough of food material. What is wanted is demonstration and enterprise.

NURSERIES

These plantations can help villagers all over the Punjab and elsewhere by supplying them stock for planting. Millions of mulberry and *shisham* stumps (root and shoot cuttings) can be supplied at nominal rates. The hill people need them for stabilizing the failing hill sides and rearing silk worms. The Public Works Department and District Boards need trees along their canals and roads not only to form avenues and to protect the surface of kacha roads but also to help in checking water-logging. The villagers need them for shade. All this demand can easily be met with from plantations.

In Khanewal about 4 million plants were raised and planted during 1936-38. During 1940 about 400,000 were planted in Chichawatni and about 160,000 supplied to Irrigation Department, P.W.D. (Buildings and Roads), District Board, Anti-Erosion Works and others.

GAME RESERVES AND SANCTUARIES

These plantations act not only as game preserves and sanctuaries for all sorts of animals and birds but they also attract migratory birds like starlings. When mulberry is in fruit millions of starlings visit

these plantations. In other months also these are seen picking insects, etc. The advantages of starlings to the cultivator are well known and this alone should induce us to have more plantations.

The importance of forests to a country, agricultural or industrial, developed or undeveloped, needs no elucidation. Every other country is trying to have a certain percentage of the area under forests. 20 per cent. is considered to be the minimum. This figure is not to be worked on all-India or Provincial basis but in my opinion every district must have a certain percentage of its area under forest. If this test is applied we will find that we are far behind the times and need more plantations. Punjab is leading and showing the way in most of the works of country's uplift. Why not in this as well? More Chhangamangas and Sialkots are wanted. Punjab can be world supplier of sports goods. Let us hope it becomes one.

TIMBER PRICE LIST, DECEMBER 1941-JANUARY 1942

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 48-0-0 to 115-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 72-0-0 to 130-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-7-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-14-0 to 2-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′ × 10″ × 5″ ..	
,, ..	,, ..	Punjab ..	12′ × 10″ × 5″ ..	Rs. 8-1-6 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′ × 10″ × 5″ ..	
,, ..	,, ..	Punjab ..	10′ × 10″ × 5″ ..	
,, ..	,, ..	U. P. ..	9′ × 10″ × 5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	Re. 1-10-0 to 2-2-0 per c.ft.
,, ..	,, ..	Punjab ..	9′ × 10″ × 5″ ..	Rs. 7-10-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′ × 10″ × 5″ ..	Rs. 4-11-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
,, ..	,, ..	Assam ..	Squares ..	
,, ..	,, ..	Bengal ..	Logs ..	
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	
,, ..	,, ..	Bombay ..	Squares ..	Rs. 32-0-0 to 80-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-15-2 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-9-0 to 0-12-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-10-0 to 0-14-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers ..	Rs. 7-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 68-0-0 to 160-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Re. 1-7-9 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 per c. ft.
,, ..	,, ..	Madras ..	Logs ..	
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 85-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-11-5 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel	*Terminalia tomentosa*	Bihar	Logs	Re. 0-9-0 per c.ft.
,,	,,	Orissa	Logs	Re. 0-8-0 to 0-12-0 per c.ft.
,,	,,	Madras	Logs	
Mesua	*Mesua ferrea*	Madras	B. G. sleepers	Rs. 7-0-0 each.
Mulberry	*Morus alba*	Punjab	Logs	Rs. 1-15-9 to 3-5-1 per c.ft.
Padauk	*Pterocarpus dalbergioides*	Andamans	Squares	
Sal	*Shorea robusta*	Assam	Logs	
,,	,,	,,	B. G. sleepers	
,,	,,	,,	M. G. sleepers	
,,	,,	Bengal	Logs	
,,	,,	Bihar	Logs	Re. 0-7-0 to 1-4-0 per c.ft.
,,	,,	,,	B. G. sleepers	Rs. 7-0-0 each.
,,	,,	,,	M. G. sleepers	Rs. 2-8-0 each.
,,	,,	C. P.	Logs	Re. 1-2-0 to 1-4-0 per c.ft.
,,	,,	Orissa	Logs	Re. 0-12-0 to 1-12-0 per c.ft.
,,	,,	U. P.	Logs	Rs. 1-8-0 to 1-12-0 per c.ft.
,,	,,	,,	M. G. sleepers	Rs. 2-8-0 to 2-12-0 each.
,,	,,	,,	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood	*Santalum album*	Madras	Billets	
Sandan	*Ougeinia dalbergioides*	C. P.	Logs	Re. 1-9-6 per c.ft.
,,	,,	Bihar	Logs	Re. 1-0-0 per c.ft.
,,	,,	Orissa	Logs	Re. 0-12-0 to 1-4-0 per c.ft.
Semul	*Bombax malabaricum*	Assam	Logs	
,,	,,	Bihar	Scantlings	Rs. 0-8-0 to 0-10-0 per c.ft.
,,	,,	Madras	Logs	
Sissoo	*Dalbergia sissoo*	Punjab	Logs	Rs. 1-4-5 to 1-6-6 per c.ft.
,,	,,	U. P.	Logs	Re. 1-8-0 to 1-12-0 per c.ft.
,,	,,	Bengal	Logs	
Sundri	*Heritiera* spp.	Bengal	Scantlings	
Teak	*Tectona grandis*	Calcutta	Logs 1st class	
,,	,,	,,	Logs 2nd class	
,,	,,	C. P.	Logs	Re. 1-2-4 to 2-14-7 per c.ft.
,,	,,	,,	Squares	Rs. 1-10-9 to 2-11-0 per c.ft.
	,,	Madras	Logs	
	,,	Bombay	Logs	Rs. 66-0-0 to 340-0-0 per ton.
	,,	,,	M. G. sleepers	Rs. 6-0-0 each.
White dhup	*Canarium euphyllum*	Andamans	Logs	

Financial Results.—The revenue from timber and fuel amounted to Rs. 77,646 and Rs. 4,45,990 as against Rs. 88,677 and Rs. 4,99,159 in 1939-40, respectively. The gross revenue during the year amounted to Rs. 7,31,248 as against Rs. 7,76,348 in 1939-40. The expenditure approximated to Rs. 3,73,587 showing an increase of Rs. 7,807 over the previous year's figure of Rs. 3,65,780, with a surplus of Rs. 3,57,661 which is deficient by Rs. 52,907 than the previous year. Considering the numerous handicaps to which the Sind forests were subjected, these results are by all means encouraging. A saving of 49 per cent. of the gross revenue compares very favourably with other provinces under similar conditions.

Erosion and Anti-erosion Measures.—The total area eroded during the year was 7,860 acres showing an increase of 871 acres over the previous year when it was 6,989 acres only. Excepting the Sukkur Division, which reports the exceptionally low figure of 100 acres only eroded, the menace has been on the increase everywhere.

G. S. S.

EXTRACTS

FARMERS AND FORESTS

Wood, the product of forests, is so much a part of the every-day life of all of us that we tend to forget how necessary forests are. From birth to death a man is dependent on wood. He is born on a wooden bed, often feeds with a wooden spoon from a wooden bowl, uses at school wooden rulers and writes on a wooden slate, plays his games with wooden hockey sticks, sits on a wooden chair, does his work at a wooden table, wears wooden clothes (artificial silk), reads a wooden newspaper (newsprint), and eventually when he is dead, is carried away on a wooden stretcher to be buried in a wooden coffin or burnt with a wooden fire.

We all need wood for our houses, wood for our carts, wood for our trains, wood for our ships, wood even for our aeroplanes; our medicines often come from wood products (Cinchona bark) and it is impossible to pass through any day without making continuous use of wood or wood products.

It is sometimes suggested that the numerous substitutes used nowadays for wood will lessen the demand, but new uses for wood arise even more quickly than substitutes for it, so that, for as far back in the world's history as we have records, the annual consumption of wood per head of population has steadily risen.

It is not only wood and ordinary wood products that the forests provide. They provide both grazing for the cattle and shade for them. Above all, for the ordinary villager they provide fuel.

If you do not live near forests you will know how difficult it is for you to get suitable fuel. You will know that crores of maunds of cowdung are burnt yearly as fuel and the burning of this valuable source of manure deprives the fields of its benefits, reduces the fertility of the soil and consequently the food available in India. But near most farms there is land which is not suitable for growing agricultural crops and yet which would very easily support forest crops. Nor need this necessarily encroach on the village grazing land because by regulating the grazing, the farmer can very easily increase the production of hay by three or four hundred per cent. The numerous mango *baghs* in India are often badly managed and if treated properly could not only produce more mangoes, if mangoes are required, but could produce a large quantity of fuel from quick grown species which would go far to solve the fuel problem in those areas where fuel is scarce.

It is sometimes stated that the Indian villager prefers to burn cowdung rather than wood because of its peculiarly slow-burning and smouldering properties. But given a cheap local wood fuel he would usually substitute it for cowdung. Even for those very slow-burning process for which the cowdung seems necessary, a perfectly good substitute could be made locally in the villages by first burning the wood into charcoal and then making the charcoal into what are called briquettes which, if mixed with clay, can be made to smoulder away as gradually as cowdung.

If gradually the uses of locally grown fuel could be substituted for cowdung and the cowdung released for manuring the fields, the whole economy of the countryside might be changed.

Near many of the large reserved forests in Northern India, there has arisen a very close relationship between the agriculturist and the

forest officer. A system called *taungya,* or perhaps more popularly *ban kheti,* has enabled them to give mutual help to each other. The forest officer is not the enemy of the villagers he is often supposed to be, and if you enquire from these *taungya* villagers you will find he is often their best friend. The system is that when the forester cuts down the forest at maturity, he then allows the villager to cultivate the land free of charge. Depending on the forest species this cultivation in a given place may last from two to four years. The villager sows his crop in the normal way and reaps the produce which belongs to him. In addition, he is given free grazing for plough-cattle, firewood and various other small amenities. In return he sows the forest crop in lines between his own agricultural crop. The trees grow and in the second to fourth year, depending on the species, they close up and make the crop unprofitable for the agriculturist who then moves on to another plot. The forest officer has so arranged matters that the *taungya* villager can revolve in a circle round his village so that he is never without his normal annual area for cultivation.

Anyone who has seen the crops of the *taungya* cultivators knows how far superior they are to those on the poor tired land outside the forests. The forest department took these villagers poor, starving and sometimes criminal, advanced sufficient money for the seed crop and, within a few years, there were prosperous and contented villagers comparatively well off with their own schools and doctors and able to provide the following seed crop from their own resources. In addition to all this, forest work is largely seasonal and it happens to fit in with the slack season of the cultivator so that at those periods of the year when he is not engaged in his own work he can find employment in the neighbouring forests. Those villagers look upon the forest and the forest department as their best friend.

But there is a further way in which forests affect the farmer. If any of you have seen the terrible ravine lands of the Jumna and Chambal rivers where more than 200 square miles of the earth's surface have been rendered useless and unproductive, an area which is increasing by over 250 acres every year, you will realise that these ravines are an ever-increasing menace. Gradually they extend into the fields till they also become useless ravines and whole villages have

been swallowed up in the general destruction. Look again at the devastated areas of the Hoshiarpur *chos* in the Punjab where between 1854 and 1897 nearly 50,000 acres of land was overrun by torrent beds. The land value of villages in the Hoshiarpur and Jullundur districts decreased by 20 lakhs of rupees between 1884 and 1897. Now although the flooding and erosion of these places is obvious to everybody, it is not always so obvious that this is happening in a minor way over very much larger areas. Even the damage caused below the Siwalik hills of the Punjab and among the Etawah ravines, though it must be checked by local work, has its origin miles away in the deforested Himalayan mountains. If the head-waters of streams are covered with properly managed forests, the monsoon rain is caught first by the leaves, then gently drifts to earth and is slowly absorbed by the sponge-like mass of damp vegetation which covers the ground. It slowly seeps into the various streams, the beds of which are large enough to drain it all away for use in the plains. But where these same areas are bare and deforested the water runs off at such a pace that the rivers become over-full and eventually flooded and devastate the country lower down. Thousands of tons of soil are washed away and lost.

But there is a further danger. People do not realise the immense carrying power of water. A stream flowing at two miles an hour may carry along a stone of the size of a chicken's egg. Double the rate of that flow to four miles an hour and it would carry stones as large as a football, while a torrent going at 20 miles an hour would carry along a rock weighing 3,000 maunds. And even that is not all. If a stream travelling at two miles an hour can grind and wear away the land (erosion) at a certain pace, then the torrent of 20 miles an hour will have one hundred times the erosive power.

So you have a vicious circle on the deforested hillside. The flood increases the carrying power and the increased carrying power further increases the scour which deepens the beds, increases the slope and further increases the velocity and so it goes on. It is the lowering of the bed of the Jumna by the scouring power caused by the floods of the deforested Himalayas and the increased drainage of the Jumna which eventually formed the Etawah ravines.

If, therefore, the farmer is to protect his homestead, he must always be on the watch for the beginnings of floods and erosion on

his own land and because he will suffer from the floods caused by the deforestation of catchment areas, and especially mountain catchment areas, perhaps hundreds of miles away, so he should see to it that no part of his native land is abused.

It is an axiom in many civilised countries that the high level catchment areas of rivers must be kept afforested. In parts of Europe the law is such that nobody, whether the State or private owner, may deforest the high level catchment areas.

Forestry has often been called the handmaid of agriculture. This is even more true of a country of extremes of climate like India than of the more temperate European climates. Europe can stand the misuse of land without the terrible retribution which follows in countries like India, China or the southern portion of the United States. If those countries are not to lose their most valuable asset, namely, their soil fertility, they cannot afford to forget the great influence that forests wield. The abuse of land culture, which after all is the farmer's job, will bring in its train as terrible a punishment as has overtaken those who dwelt in the ravine lands of Etawah where, it may be remembered, there once flourished a *sal* forest.—*Indian Farming,* Vol. II, No. 10, dated October, 1941.

HOW MANY SPECIES OF PLANTS ARE THERE?

Recently during the course of investigations of general systematics of plants, it has been noted that current text books of Botany for university students contain discrepant and often contradictory statements of the number of existing species of *Angiosperms*. For example, according to a dozen books examined, the number of species of all *Angiosperms* varies from 133,000 to 175,000; of *Dicotyledons* 100,000 to 140,000; and of *Monocotyledons* 24,000 to 35,000. The number of *Gymnosperms* usually is said to be 500, and the total of all living species of plants is frequently estimated to be about 250,000. The methods used by the authors of these books in obtaining these figures is not revealed, but it is clear that the relatively simple expedient of consulting reasonably accurate recent sources of taxonomic data was not employed.

It occurred to me, therefore, that in view of the fact that these estimates appear to have been based upon antiquated data, it may be

worth while to present a more accurate summary. According to a compilation made partly from the eleventh edition (1936) of "Die Syllabus der Pflanzenfamilien" (Engler and Diels), and partly from recent monographs and other sources, the *Angiosperms* contain a total of 195,000 known species; of these, 155,000 are *Dicotyledons,* and 40,000 are *Monocotyledons.* There are approximately 640 species of *Gymnosperms.* On the basis of figures supplied by G. M. Smith*, there are (with the addition of *Bacteria*) 107,570 species of *Thallophyta* and 23,000 species of *Bryophta.* The *Pteridophyta* contain about 10,000 species, of which 9,000 belong to the *Filicales*†.

Thus, the conclusion may be drawn that on a conservative basis, the approximate total number of different species of known living plants is slightly in excess of 335,000. The rate of discovery and description of new species of flowering plants during the twenty-five-year period from 1910 to 1935 has been reported by E. D. Merrill as averaging at least 4,800 per year‡.

G. NEVILLE JONES,
—*Science,* Vol. 94, No. 2436,
UNIVERSITY OF ILLINOIS. dated September 5, 1941.

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HILL CULTURE

BY COLIN MAHER, M.A., DIP. AGRIC. (CANTAB.), A.I.C.T.A., OFFICER IN CHARGE, SOIL CONSERVATION SERVICE, DEPARTMENT OF AGRICULTURE KENYA COLONY

The rapid loss in fertility that occurs on steep slopes is appreciated even by primitive natives. Steep hillsides may be cultivated for one year only, after clearing the bush, and the land will then be left in bush-fallow for periods varying with the degree of pressure of population upon the land. In the United States, steep lands are commonly "retired from cropping," and are restored

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* "Cryptogamic Botany," Vol. I, 1938, McGraw-Hill Book Co.

† C. Christensen in Verdoorn's "Manual of Pteridology," The Hague, 1938.

‡ "Memoirs Brooklyns Botanic Garden," 4: 57-70, 1936.

to pasture or forest by protection or planting. It is not often that this ideal land-use solution can be applied in East Africa. Population densities in crowded areas may be from 300 to over 1,200 per square mile, and it is not possible to remove people from steep hillsides in such areas owing to lack of more suitable land on which to resettle them. In the circumstances, the best that can be done is to recommend such measures as will slow down the rate of erosion, while still permitting a fair density of population.

The first measure that suggests itself is the construction of bench terraces built on the contour. This form of erosion control has enabled fairly dense populations to cling to hillsides throughout the ages, and all over the world. Traces of stone terracing by more sedentary agricultural tribes who occupied East Africa one or two centuries ago have been found in many parts of the territories. But the construction and maintenance of terraces is laborious and extremely expensive. American experts calculate that terraces on Peruvian mountain-sides represent an expenditure in construction and maintenance by the ancient Incas, over several centuries, which is equivalent to $18,000 to $35,000 (£3,600 to £7,000) an acre. Generally, the cost of terracing, except where it is a matter of sheer life-or-death subsistence, can only be defended where saleable crops of high value can be produced, such as grapes, olives, carobs and figs in the Mediterranean countries, citrus in California, rice in the Philippines.

Moreover, terraces introduce drainage problems which may be difficult of solution. At best, systems of terraces on steep hillsides require constant attention and maintenance if they are not to be destroyed by gullying. This is especially liable to happen if the terrace lines are not spaced correctly and accurately in the first place.

Some of the difficulties that must be faced in connexion with bench terraces, whether formed gradually by erosion or, by great labour, in one operation, will be discussed in a subsequent article. In the present article I wish to discuss the possibilities of another method of hill-culture in which the ecological botanist, the horticulturist and the forester take charge, while the engineer retires into the background.

The philosophy underlying this means of enabling hillsides to be kept under permanent and beneficial occupation in densely populated areas has been set forth in a most interesting manner by J. Russell Smith, now Professor of Economic Geography at Columbia University, New York City, in his stimulating book *Tree Crops,* which was published in 1929 and which deserves a wider public.

Briefly, the idea which Professor Russell Smith has striven to impart is that erosion on hillsides is the disastrous result of growing crops and applying methods of agriculture that are suitable only to plains lands. Annual crops ike the grain crops have weak roots which fail to hold the soil, while their cultivation involves continual loosening of the soil and its exposure to the risk of erosion by running water.

On the other hand, trees have sturdy roots which bind the soil, their culture does not necessitate frequent breaking of the soil, and they are better adapted with their wide-searching root systems to resist drought and to take advanage of all the rain that falls. Trees will often flourish on shallow soil, thrusting their roots deep into niches in the rocks. This is not all. The resources of vegetative reproduction are available for use in multiplying single "sports" or hybrids of trees with valuable characteristics, while with annual crops it is necessary laboriously to breed seeds that will come true to type.

The problem then is to collect, test, select, and multiply valuable tree and bush crops and perennial plants, both indigenous and exotic. These crops may provide shelter from wind, fuel, timber, economic products such as drugs, tannins, essential oils, fibres or dyes, food for man in the form of fruits or nuts, or food for animals in the shape of pods, fruits or forage.

The possibilities of our local trees and shrubs for medicinal and food purposes have not been fully explored by the different specialists concerned, nor has sufficient attention been paid to our indigenous *Acacia* sp. and other trees and browse plants which supply food for animals in the semi-arid parts of East Africa. Much traditional lore of plants amongst the native tribes, handed down by word of mouth from father to son, is becoming lost as the younger generation receives a smattering of our Western knowledge at school in

place of the old family instruction in economic botany. We should rescue and utilize this native learning before it is lost for ever.

In the matter of food plants, we have sufficient knowledge of fruits and nuts to make a fairly long list of woody plants and perennials that will grow satisfactorily in various parts of East Africa, though no one would suggest that, beyond issuing a few thousand trees of various species, we have gone far in the introduction of tree-culture as a means of life of natives living on the hills. Such a list might read as follows:—

Food Plants—

Pawpaw, Avocado, Orange, Lemon, Grape Fruit, Lime, Mango, Peach, Plum, Fig, Date, Oil Palm, Cocoa-nut, Almond, Guava, Banana, Olive, Mulberry, Loquat, Grape, Pomegranate, Passion Fruit, Jack Fruit, Carob Bean, Cashew Nut, Soursop, Sweetsop, Carambola, Durian, Litchi, Rambutan.

Economic woody plants, other than food plants, include—

Coffee, Tea, Ylang, Areca Nut, Tung Oil (*Aleurites fordii* and *A. montana*), Kapok, Cinchona, Rubber, Tara Bean, Nutmeg, Clove, Cinnamon.

These lists by no means exhaust the possibilities of trees and woody plants which might be grown on hillsides. I have mentioned olives in the list, but it is uncertain whether this crop has yet been grown successfully in East Africa. It would seem likely that success might be attained if imported commercial budwood were grafted on to indigenous olive stocks. In South Africa the European olive has been budded successfully on to *Olea verrucosa,* a wild olive which occurs throughout the Union of South Africa, the Kalahari, Southern Rhodesia and Portuguese East Africa. Incidentally, *Olea verrucosa* which was imported by the Kenya Department of Agriculture in April, 1937, provides, like the Kenya olive, durable and handsome timber and excellent fence posts, while the seed, leaves and twigs are eaten by almost all herbivorous animals.

During the last few years the Department of Agriculture, Kenya Colony, has made trials of fodder trees at Machakos and Rongai. A trial at Naivasha was a failure, but a new fodder tree arboretum was started at the end of 1938 near Narok in the Masai Reserve, while

fodder trees are being included in a trial of fodder crops on Mr. Thompson's farm at Nanyuki.

A report made by the Officer in charge of Grassland Improvement on the progress of the Machakos and Rongai trials of fodder trees and shrubs to September 1938, dealt with species of *Brachychiton, Eucalyptus, Phytolacca, Disperma, Celtis, Acacia, Prosopis* and *Casuarina,* and showed that at Machakos all made fair growth except *Prosopis juliflora* and *Casuarina stricta. Disperma trachy phyllum* grew strongly, seeded prolifically, and afforded a complete ground cover. Australian salt-bush and spineless cactus were both making good growth. At Rongai only the *Casuarina* and *Eucalyptus microtheca* managed to withstand the conditions; the majority of the others succumbed either to drought or to the ravages of buck (this in spite of a wire-and-netting fence).

Trials of *Acacia giraffae, Olea verrucosa* and *Zizyphus mucronata* are in progress at Nanyuki, the seed having been obtained from Pretoria.

In addition to the trees and bushes which have already been mentioned, a few notes may be given on other plants which have been tried in the Colony.

The Old Man Salt Bush (*Atriplex nummularia*) and the Creeping Salt Bush (*A. semibaccata*) have been grown in the Kamasia Reserve for several years. These growse bushes grow well (Old Man Salt Bush reaching a height of five feet) and are relished by stock.

The Bottle Tree or Kurrajong (*Brachychiton populneum*), a noted Australian fodder tree, has made excellent growth in many parts of the Colony, including Nairobi, Kitale, Endebess, and the Kamasia Reserve.

Spineless Cactus has a strong adherent in Mr. Hodgson of Athi River, who has grown it for many years. This fodder plant is also under trial at Nanyuki, in the Kamasia Reserve, and other native areas.

Karoo Bush (*Pentzia incana*) and the browse plants *Tetragonia Arbuscula* and *Tripteris pachyteris,* were obtained from the Department of Agriculture, Pretoria at the end of 1938, and are under trial at Machakos, Rongai and Nanyuki.

SUGGESTIONS FOR FURTHER TRIALS.

Prosopis juliflora, the Mesquite, Honey Locust, Algaroba or Keawe, has shown great promise at Taveta, where some seeds imported by Major E. S. Grogan from Honolulu were planted three or four years ago. This fodder tree is of high value in Hawaii, to which country it is thought it was brought from South America. There are said to be eighteen or more species of Prosopis, which occurs from Texas to Chile, and also in the West Indies, Argentine, Ecuador, Peru, Bolivia, and Paraguay. It thrives best at low altitudes, though in Hawaii it is found up to two thousand feet. The New Mexico, Arizona and Texas species are rather slow-growing, and the Hawaiian plant is likely to give better results in East Africa. Prof. Russell Smith recommended to the writer that a culture of the appropriate root bacteria for inoculating these trees should be obtained from Hawaii.

The algaroba wood is good for fuel, and the smaller branches for charcoal. The bark contains tannin and the gum is suitable for the manufacture of varnish. However, the chief use of the tree is as a forage crop. The beans are eaten and relished by chickens, pigs, horses and cattle. The yield per acre has been found to vary from two to ten tons. Meal made from the ground pods is considered in Hawaii to be equal to barley and oats for feeding purposes.

The tree has the fortunate characteristic of being able to thrive in barren, dry and rocky land which otherwise would have no value. On one ranch in Hawaii it is said that an acre of good algaroba trees will fatten at least six head of cattle, raising their weight two hundred pounds in ninety days. This is in country with a rainfall of only twenty inches.

Ceratonia Siliqua (the Carob, Carob Bean, Algaroba, or Locust Bean).—This tree has been tried with varying success in Kenya. Attempts at budding trees in the Nairobi Arboretum and seedling trees at the Scott Agricultural Laboratories with bud-wood imported from Cyprus, where carobs are an important crop, have hitherto resulted in failure. However, Mr. J. W. Newton of Turbo has some seedling carob trees which have been bearing heavy crops.

The carob is used for forage for heavy draft animals, and less extensively as forage for sheep, goats, cows and pigs. The finer

varieties of bean are sometimes ground and used with wheat flour for human food, while Russell Smith states that "cereal food," candy and syrup have been made from the beans in California. The bean is said to contain 24 per cent. protein and $47\frac{1}{2}$ per cent. carbohydrate.

Gleditschia triacanthos, the Honey Locust, is suited to climates in which maize and cotton will grow, but it will grow also in fairly arid country with a rainfall as little as 20 or 25 inches; indeed, it is recorded as having done well, without irrigation, under a rainfall of fourteen inches in Colorado and sixteen inches in Western Nebraska. This leguminous tree gives good timber, and a tree may produce twenty bushels of pods, which are devoured greedily, whole, by cows and pigs.

I have mentioned the possibility of greater use of indigenous East African *Accacia* sp., such as *A. pennata, A. spirocarpa* and *A. seyal*, the pods of which are eaten by stock in the dry weather. It is highly probable that investigation would reveal many indigenous trees and bushes worthy of attention for hill culture, and to provide a forage reserve in the more arid parts of East Africa. Seed of these trees might be scattered to replace valueless bush.

India, Australia, Rhodesia, and Brazil also might prove to be sources of valuable leguminous fodder trees for use in East Africa.*

Browse plants indigenous to the United States which are worth trying in certain areas are the following: —

Grayia spinosa.—Hop-sage; excellent forage for sheep.

Atriplex sp.—Shadscale; good forage for sheep.

Artemisia frigida.—Fringed sage bush; helpful in preventing erosion and a good forage plant.

Pershia tridentata.—Antelope Brush; highly prized for cattle and sheep, since it produces solid fat in the animals.

Artemisia tridentata.—Big Sage Brush; a good forage bush, especially in Utah and Nevada, and will stand heavy grazing.

Balsamorrhiza sagittata.—Arrow-leaved Balsam Root; has excellent forage value and grows on poor, rocky soil.

Anisacanthus Thurberi.—Desert Honeysuckle; an Arizona browse plant for cattle.

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* During certain period of the year the Indian cowkeepers in Mauritius feed their milch cows almost entirely on clippings from *Leucaena glauca*, which is found growing everywhere on uncultivated land.—*Ed.*

These and other American desert plants deserve trial in that they are accustomed to arid conditions and extreme summer heat, although it is not known how they would react to a climate in which they would not have to suffer a winter.

TECHNIQUE OF TREE-CULTURE ON HILLSIDES

The use of trees on steep hillsides to preserve the soil and to provide food for man and beast is worthy of the provision of special experimental and demonstrational areas in various parts of East Africa under different climatic conditions.

In general, contour planting is necessary, while rough contour walls of stones could be constructed in some districts. Failing the provision of contour banks or walls, a series of silt pits would assist to conserve water and enable it to soak down to the tree roots.

Many of the fodder trees such as the Bottle Tree and the Portuguese Elm are at their best when growing near a river side, and these trees probably would do best if planted along the sides of the larger gullies and watercourses on the hill slopes.

In arid districts, trees are generally found in natural depressions or near watercourses, where they obtain additional moisture. For this reason, whether on relatively flat land or on hillsides, in arid districts it will be found best to plant fodder trees behind contour banks designed to hold water, while it may be possible to divert road drainage water or other surplus run-off to add to the supply.

It should be feasible to work out systems of agriculture for use on hillsides at various altitudes and with different average annual rainfalls, in which food for man and beast would be derived almost entirely from woody or perennial crops. This vegetation would conserve the soil and allow of permanent occupation of the hill slopes.

Belts of Napier grass* (*Pennisetum purpureum*) grown for cattle fodder on the moister hills would be substituted on the more arid slopes by spineless cactus (*Opuntia sp.*), *Agave americana,* Old Man Salt Bush (*Atriplex nummularia*) and other drought-resistant bushes and plants, with a second story of pod-bearing *Acacia* sp., mesquite and other fodder trees.

The people would depend largely for food on the fruit and nut-bearing trees that have been mentioned earlier, exchanging surplus amounts of these food-stuffs for grain grown by natives on flatter land on the plains below the hills. Some of the tree crops, like almonds and olives, would have a value for cash sale; others

* Napier grass=Elephant grass.—*Ed.*

would afford the raw materials for the extract of oils, tannins, dyes, or perfumes, for canned juices and fruits.

The possibilities are vast, but a study of the collection of plants that are under trial by the Hill Cultures Section of the Soil Conservation Service of the United States Department of Agriculture, to which I am indebted for the appended list, suggests that this work could not be treated as a side-line, but that the collection and examination of indigenous and exotic perennial tree-crops and other perennial bushes and plants for economic value would constitute full-time employment. The collection of species and the examination of eventual results is a large task in itself, but continual study is necessary also in order to facilitate subsequent selection and breeding work, together with experimental work on cultural techniques and methods of use of the plant products.

LIST OF PLANTS

Name of Plant	Popular Name	Purpose
Pinus Parryana ..	Nut-pine ..	Edible nut, timber.
Quercus deciduus ..	Oak ..	Acorns for fodder.
Quercus agrifolia ..	Oak ..	Acorns for fodder.
Umbellularia californica ..	California laurel ..	Shade tree.
Castanea mollissima ..	— ..	Edible nut.
Prunus Lyonii ..	Islands cherry ..	Fruit.
Prunus ilicifolia ..	Wild cherry ..	Fruit.
Prunus Armeniaca sibirica ..	Apricot ..	Fruit.
Simmondsia californica ..	Pig nut ..	Oily seed and edible fruit.
Ilex cornuta ..	Holly ..	Decorative.
Ilex Aquifolium ..	English holly ..	Decorative.
Ilex Aquifolium fertilus ..	English holly ..	Decorative.
Pistacia vera var. *Aleppo* ..	Pistachio ..	Edible nut.
Pistacia vera var. *Bronte* ..	Pistachio ..	Edible nut.
Pisracia vera var. *Kaz* ..	Pistachio ..	Edible nut.
Prosopis sp. ..	Mesquite ..	Fodder.
Ceanothus sp. ..	Ceanothus ..	Decorative.
Juglans californica ..	Walnut ..	Edible nut.
Pentzia incana ..	Karoo-bush ..	Browse plant.
Acacia sp. ..	Acacia ..	Fodder.
Zizyphus Jujuba ..	Jujube ..	Fruit.
Gleditschia triacanthos ..	Honey locust ..	Fodder.
Diospyrss Kaki ..	Persimmon ..	Fruit and fodder.
Rhus sp. ..	Sumach ..	Tannin.
Photinia arbutifolia ..	Tollon ..	Fruit.
Hicoria Pecan ..	Pecan ..	Edible nut.
Castanopsis sempervirens ..	— ..	Edible nut.
Castenea Seguinii ..	.. ..	Edible nut.
Corylus rostrata ..	Hazel ..	Edible nut.
Corylus americana ..	Hazel ..	Edible nut.
Elaeagnus multiflora ..	Gumi ..	Fruit.
Myrica rubra ..	— ..	Fruit.

LIST OF PLANTS—(*Contd.*)

Name of Plant	Popular Name	Purpose
Juglans nigra ..	Black walnut ..	Edible nut.
Juglans Hindsii ..	Walnut ..	Edible nut.
Juglans boliviana ..	Walnut ..	Edible nut.
Juglans Sieboldiana ..	Walnut ..	Edible nut.
Pinus monophylla ..	Pine ..	Timber.
Castanes hybrids ..	— ..	Fruit.
Diospyros virginiana ..	Common persimmon ..	Fruit and forage.
Olea sp. ..	Olive ..	Fruit.
Ficus sp. ..	Fig ..	Fruit.
Morus sp. ..	Mulberry ..	Fruit.
Ceratonia Siliqua ..	Carob ..	Forage.
Robinia Pseudacacia ..	Black locust ..	Timber.
Albizzia kalkora ..	— ..	Ornamental.
Paulownia Fortunei ..	.. ..	Ornamental.
Cedrela sinensis ..	— ..	Ornamental.
Eisenhardtia sp. ..	— ..	—
Torreya californica ..	Californian nutmeg ..	—
Punica granatum ..	Pomegranate ..	Fruit.
Feijoa Coolidgeii ..	Fejjoa or pineapple guava	Fruit.
Eugenia uniflora ..	Pitanga or surinam cherry ..	Fruit.
Macadamia ternifolia ..	Queensland nut ..	Fruit.
Mammea americana ..	Mammee apple ..	Fruit.
Amygdalus communis ..	Almond ..	Edible nut.
Aleurites Fordii ..	Tung oil ..	Oil nut.
Yucca baccata ..	Yucca ..	Fruit.
Agave sp. ..	Sisal ..	Fibre.
Aloe sp. ..	Aloes ..	Drugs.
Argania spinosa ..	— ..	—
Lyonothamus floribundus ..	Lyon shrub ..	Ornamental.
Pyrus kawakami ..	— ..	Fruit.
Quillaja Saponaria ..	Soap-bark tree ..	Alkali.
Cratægus Arnoldiana ..	Hawthorn ..	—
Chænomelos sp. and var. ..	Quince ..	Fruit.
Sambucus sp. and vars. ..	Elder ..	Fruit.
Prinsepia sinensis ..	— ..	Oil from seeds.
Carissa grandiflora ..	Natal plum ..	Fruit, hedge plant.
Berberis Nevinii ..	Barberry ..	Fruit.
Cratægus pinnatifida ..	Hawthorn ..	—
Cratægus Lauta ..	Hawthorn ..	—
Xylosma senticosum ..	— ..	—
Viburnum americanum ..	— ..	Ornamental.
Arctostaphylos glauca ..	Manzanita ..	Ornamental.
Cudrania tricaspidata ..	Silkworm thorn ..	Edible, hedge plant.
Phellodendron sp. (Velvet tree) ..	Velvet or cork tree ..	Ornamental.
Prunus Besseyi ..	Western sand cherry ..	Fruit.
Ephedra sp. ..	Ephedra ..	Drug.
Actinidia chinensis ..	(Climbing shrub) ..	Fruit.
Actinidia arguta ..	(Climbing shrub) ..	Fruit.
Vitis sp. ..	Grape ..	Fruit.
Rubus parvifolia ..	Cork oak ..	Cork.
Acacia detinens ..	— ..	Fodder, tannin.
Acacia Cavenia ..	Espino cavan ..	Tannin, hedge plant.

LIST OF PLANTS—(*Contd*).

Name of Plant	Popular Name	Purpose
Acacia Farnesiana ..	Popinac ..	Perfume.
Mayer lemon ..	— ..	Fruit.
Rangpur lime ..	— ..	Fruit.
Hibiscus Sabdariffa ..	Roselle ..	Fruit.
Chrysanthemum cinerariæfolium ..	Pyrethrum ..	Flowers.
Leucæna glauca ..	.. ..	Fodder.
Phormium tenax ..	New Zealand flax ..	Fibre.
Crotalaria juncea ..	Sunn hemp ..	Fibre.
Acacia Berlandieri ..	— ..	—
Porlieria angustifolia ..	.. ..	—
Tilia phanera ..	.. ..	..
Stachys Drummondii ..	Hedge nettle ..	—
Fremontia mexicana ..	— ..	—
Arbutus Andrachne ..	— ..	—
Baccharis pilularis ..	— ..	Ornamental.
Baccharis pediclaris ..	— ..	Ornamental.
Eriogonum fascicilatum ..	— ..	Ornamental.
Eriogonum grande ..	— ..	Ornamental.
Eriogonum rubescens ..	— ..	Ornamental.
Eriogonum cinereum ..	— ..	Ornamental.
Atriplex semibaccata ..	Creeping salt bush ..	Browse plant.
Atriplex confertifolia ..	— ..	Browse plant.
Galium angustifolium ..	Bedstraw ..	—
Galium Nuttallii ..	Bedstraw ..	—
Hymenanthera crassifolia ..	.. ..	Ornamental.
Chamoebatia foliolosa ..	— ..	Ornamental.
Eriodictyon californica ..	— ..	Ornamental.
Echium Wildpretti ..	Viper's bugloss ..	Ornamental.
Kennedya Comptoniana ..	— ..	Ornamental.
Sanguisorba minor ..	— ..	Ornamental.
Fragaria chilœnsis ..	Wild strawberry ..	Fruit.
Perifzia virgata ..	— ..	—
Jasminum imprimulatum ..	Jasmine ..	—
Artemisia californica ..	— ..	—
Artemisia Dracunculus ..	Tarragon ..	Seasoning.
Salvia sp. ..	Sage ..	Herbs.
Centrosema virginianum ..	— ..	Ornamental.
Lotis scoparius ..	.. ..	—
Lotus argyophyllus ..	— ..	—
Mesembryanthenum sp. ..	— ..	Erosion control.
Sedum alpinum muralis ..	Orpine or stone crop ..	Erosion control.
Lippia repens ..	Verbena ..	—
Rumex hymenosepalus ..	Dock ..	—
Euphorbia sp. ..	— ..	—
MenthÆ sp. ..	Mints ..	Essential oil.
Cytisus scoparius ..	Scotch broom ..	Medicinal.
Lotus corniculatus ..	Birdsfoot terefoil ..	Forage.
Desmodium sp. ..	Tick trefoil ..	Forage.
Burbank cactus ..	.. ..	Forage.
Cneoridium sp. ..	— ..	—
Rubia tinctorum ..	Madder ..	Dye.
Acacia verticillata ..	Whorl-leaved acacia ..	Hedge plant.
Nicotiana glauca ..	Wild tobacco ..	—

—*The East African Agricultural Journal*, July, 1939.

THE NOTE

This paper includes the names and some details of various trees or shrubs which can be grown on steep land: the idea is that herbaceous food crops require intense cultivation and that on steep land erosion will be much reduced if shrubs and trees of economic value can be substituted for them. The species mentioned may be well worth propagating but it is difficult to imagine that a grain eating community can be converted within some decades to a diet of fruits and nuts subsisting "almost entirely on woody or perennial crops."

This is however an unreasonable simplification of the problem: the authors only profess to prepare a list of species which may be useful and indicate a trend to be followed in the agricultural development of steep land. Similarly the following notes are only of the most general character.

The practical and economic aspects of the scheme are interesting. Except for cocoanuts, bananas and *jak,* none of the trees mentioned afford anything like a staple food; breadfruit might be added to the list: the rest only provide cash crops or auxiliary or luxury foods. Such products as coffee, tea and rubber, while not incompatible with small holdings require a central factory for manufacture: Tung oil and citronella also need more than a peasant's acreage and facilities for extraction. None of the latter are directly interchangeable with rice or mealies on a considerable scale.

Cash crops such as cashew, almonds, need no central organisation while fruits for preserved juice can be organised on a co-operative basis.

An important factor is transport, which is closely bound up with the respective acreages under hill culture and under grain in flat lands in the immediate neighbourhood; *jak* fruits and cocoanuts are heavy and in steep terrain the radius of distribution will be limited. If only 5 per cent. of the total area has to be closed to grain cultivation because it is critically steep it is conceivable that the hill cultivators might get part of their livelihood from woody and perennial crops exchanging their produce with that of their immediate neighbours. They might be part time labourers on some Estate or Government undertaking. One trouble is that the lowlanders would themselves grow as hedgerow trees all the *jak,* etc,

they need and an agricultural population has a very small margin for outside purchases. If the whole of a large tract of country is too steep for the production of staple foods a central organisation for marketing or manufacture would be uneconomical in the early stages of the scheme; rice, etc., would have to be imported for the cultivators or wages paid for the planting of woody or perennial crops.

Fodder production is a special branch of tropical agriculture and therefore mainly outside the scope of forest activities but many grazing lands of the better type could be made more productive if fodder trees were interplanted among the grass. Under this arrangement some shade would be provided for cattle.

Dated, *August 21, 1941.*

GROWTH HORMONES

A growth-promoting hormone, more powerful than any of the synthetic chemicals now in use for speeding root formation, inducing growth of seedless fruits and other recently discovered "plant magics," has been found in pollen by Dr. John W. Mitchell and Miss Muriel Whitehead of the U. S. Department of Agriculture.

They obtained their material by extracting ripening corn pollen in ether and then evaporating the ether. A fatty substance is left, which is mixed with lanolin in a ratio of one to ten. This paste or ointment is then spread on the plant part where growth-stimulating effects are desired. A ring of it around the stem of a seedling bean plant caused an elongation between 1.5 and 2.5 times greater than that obtained by treatment of comparison plants with any of the synthetic growth regulators.

It is not unlikely that the pure substance itself, when it has finally been isolated, will have even more powerful effects, for the crude ether extract of pollen is very likely a mixture of several substances, not all of which have growth-stimulating properties.

Chemical analyses of the ether extract will be actively pushed, for if the active principle can be isolated and its chemical structure determined, it may be possible to make it artificially, at much lower cost than by extracting it from pollen.

The effectiveness of the newly discovered substance in making plant stems grow longer may be put to practical use by florists in getting longer-stemmed flowers or in producing longer-fibered stems in such textile plants as flax, hemp and ramie. Such large-scale uses will depend, of course, on working out large supplies of the chemical at low cost.

Another use that has been discovered recently for growth hormones has been in producing seedless fruits from unpollinated flowers. A large range of plants, from holly berries to tomatoes, has been thus treated with good results. Spraying orchard trees with the hormones has had the effect of restraining flower buds from opening until danger from late frost is past, of inducing apple and other trees to hang on to their fruit instead of dropping much of it prematurely and of hastening the ripening of oranges.

To obtain a supply of pollen for their researches, Dr. Mitchell and Miss Whitehead exploit bees bringing the yellow dust back to the hive. The bees are compelled to pass through a narrow, screen-lined pollen trap, which scrapes off their loads and lets them drop into a collecting box.—*Science*—Supplement, September 19, 1941. Vol. 94, No. 2438, p. 11.

IMPORTANCE OF TIMBER IN WAR

Very large quantities of timber are required by the Army in wartime and the amounts of timber that are being consumed are vastly in excess of normal peacetime requirements. During the past twelve months the quantity of timber, excluding manufactured woodware, purchased by the Department of Supply for the army amounts to over 24,800,000 cubic feet valued at about Rs. 3,34,00,000. Of this the largest portion has been purchased from the Punjab, which has supplied 9,230,000 cubic feet valued at Rs. 1,08,00,000. The greater proportion of this is the produce of Kashmir State, but considerable quantities have come from Punjab Government forests and the forests of Jubbal and Mandi States. Large supplies have also been made by the United Provinces (4,270,000 cubic feet), Madras (1,870,000 cubic feet) and Assam (1,360,000 cubic feet).

Such enormous demands for timber would, if the laws of supply and demand were allowed to have free play, cause prices to soar. The Department of Supply has, however, been able to keep prices down to a level not greatly in excess of those current in pre-war times by arranging a large portion of the purchases through the agency of the Provincial and State Forest Departments, with the co operation of which it has been possible to control prices effectively. In this way many lakhs of rupees have been saved.

The largest part of the timber supplied is used for the construction of huts for the accommodation of our troops both overseas and in India, and for prisoners of war camps. The total quantity of sawn hutting timber supplied up to date is about six and a quarter million cubic feet. Advances have been made in the use of cheap forms of construction requiring smaller quantities of timber and in the use of small round poles known as "ballies" to replace sawn timber, thereby effecting savings in the cost of the huts and reducing the load on the sawing capacity of the country. The main sources of these ballies are the United Provinces and the Central Provinces which have supplied over 14 lakhs and 12 lakhs of them respectively. Timber is also used by the army in large quantities for packing cases and boxes. These vary from the cheap packing case of low quality timber which is only intended to do a single journey, at the end of which it is probably chopped up and used by the troops for firewood, to strong, well-made boxes for ammunition, transport of petrol, stores, motor engines and many other purposes. Sleepers for railway track are required in very large quantities especially by the expeditionary forces overseas, as well as telegraph poles electric transmission poles, jetty piles, etc.

High quality timber, mostly either teak or deodar, is supplied for the construction and repair of motor-lorry bodies and for making portable bridges. Manufactured wooden articles are also supplied of kinds too many to enumerate, such as axe helves, tool handles, camp furniture, rifle parts, tent poles and tent pins, box shooks, etc. The total value of such manufactured woodware supplied up to date is approximately Rs. 1,82,00,000. The timber comes chiefly from the conifer forests of the Himalayas and from the belt of forests along the foot of the sub-Himalayan tract, from

Assam, the forests of the Western Ghats in Madras and Bombay, the teak pole forests of the Central Provinces and from the Andaman Islands, the latter producing some of the best quality timber at the lowest cost.

The methods of extracting timber from the forests are as picturesque as they are varied. It is dragged by elephants, buffaloes and bullocks or carried out by coolies on their backs, slid down by wire ropeways, or down specially constructed slides in mountainous country, carried in carts or motor lorries, sent floating down rivers and stream transported on forest tramways by steam or elephant power and, finally, sent to the sawmills or ports by rail. It leaves the forest mostly in the form of round logs or roughly hewn squares, or else as hand-sawn sleepers and beams. Much of this has then to be sawn up into planks and scantlings in sawmills in the plains. At the beginning of the war the sawing capacity of the country was totally inadequate for the demands of wartime, and it has been necessary to increase the capacity of sawmilling industry as well as hand-sawing to a great extent. It has also been necessary to arrange for large storage depots for timber at the principal ports and up-country. The labour required in timber operations from the felling of the trees in the forests up to the manufacture of the final product constitutes a very large source of employment and has largely increased the earnings of labouring classes.—*Indian Information*, Dated October 1, 1941.

INDIAN FORESTER

MARCH, 1942

FIFTEEN YEARS OF FOREST ADMINISTRATION IN THE UNITED PROVINCES: A SHORT RETROSPECT—II

By F. Robertson, I.F.S.

RECRUITMENT AND TRAINING.

A. *The Gazetted Services.*—In consonance with India's increasing political stature, the past fifteen years have witnessed considerable changes in the method of recruitment and training. The last recruits to join the I.F.S. in this province were one, British trained, in October, 1929, and one other, a product of the short-lived Indian I.F.S. course at Dehra Dun, in November, 1932; the former being the final European forest recruit to this province. Since 1932, indeed, no additions whatever have been made to our I.F.S. personnel, not even by promotions from the provincial service. The old Imperial Service, in fact, is a dying one, destined to be replaced by the indigenous "Superior Forest Service" that has already started to provide us with fully trained gazetted officers. Four of these joined the U. P. from Dehra Dun in 1940. The sanctioned I.F.S. cadre of 41 was reduced to 38 in 1933 with one post, that of Conservator, Utilisation Circle, held in abeyance ever since 1927, and the number of posts actually vacant is naturally increasing year by year. The old provincial service is likewise destined to disappear. Indeed, this province took its last direct recruits (two) as far back as 1925, since when only seven men have been added by promotion from the Subordinate Forest Service and the cadre, which was 35 in 1925, now stands at 27. In accordance with these fundamental changes, Government in 1935 sanctioned the introduction of a new intermediate Service, called the "U.P. Upper Subordinate Service," whose members, designated "Forest Assistants,' are destined to replace the disappearing P.F.S. Appointments are made by selection from forest rangers who have obtained their Forest

College certificate, and out of the cadre of sixteen permanent posts six have already been filled, as well as two temporary posts created for war purposes: and this year Government conferred gazetted status on these officers.

B. *The Subordinate Services.*—There have been only minor changes in the subordinate cadres since 1925. Rangers remain at 106, Deputy Rangers are 103, Foresters 148 and Forest Guards 869; total 1,226. But the same body of men have much more work to do and more skills to acquire than fifteen years ago; for the lower ranks, fortunately, a far better educated and intelligent type of man is nowadays available.

RESEARCH

The U. P. was one of the first provinces to appoint a Silviculturist (1918) and through the later 'twenties much of his time, apart from statistical work, continued to be spent on discovering, in co-operation with senior divisional officers, how to regenerate commercial species artificially on different soils and sites, their joint experience being put to immediate good use on a divisional scale. Other studies included the propagation of lac, which bore little result, and of *baib* grass, which eventually bore much; the development of *babul* and oak coppice, of considerable importance for fuel in their respective zones; the causes of bamboo congestion and a series of preliminary experiments on *sal* natural regeneration. In 1927 silvicultural research received a big impetus following a complete reorganization of both its method and its objectives, with a printed quinquennial programme linked with that of the Central Silviculturist. This programme, while stressing the need for further investigation into all forms of artificial regeneration and afforestation, definitely put research on the natural regeneration of *sal* into the forefront, where it has remained ever since. A new series of large-scale scientific experiments, covering many *sal* divisions and all the chief subtypes, was laid out during the earlier 'thirties and the fruit these have borne has had honourable mention elsewhere in this account (*see* "Silviculture"). Other successful enterprises of this period include the introduction and propagation of *kuth* (*Saussurea lappa*), the establishing of fuel plantations on plains *bhur* and the production of good fodder yields from semi-barren *usar* lands by

Fig. I

Kuth (Saussurea lappa) high-level nursery

Sowings of 1935 left *in situ* for seed: Bajmora, Garhwal Division (10,700 feet).

Photo: F-Robertson.

Fig. II

Natural regeneration experiment with bhabar type sal (Shorea robusta), 1933—8

Young reproduction rapidly establishing itself after biannual shrub-cutting and protection from deer, under a moderate overwood. Now vigorous pole and sapling forest: Haldwani Division.

Photo: E. C. Mobbs.

Fig. I

Natural regeneration experiment with plains type sal (Shorea robusta), 1933—8

Field party assessing progress of regeneration by stocked square method in heavy Anthisteria gigantea grass; miles of such strips have been patiently assessed year after year in various types of sal forest: N. Kheri Division.

Photo: F-Robertson.

Fig. II

A protected chir tree (Pinus longifolia)

A fine specimen, 156 feet high by 8 feet 7½ inches girth, saved from the axe: W. Almora Division.

Photo: F-Robertson.

protective treatment. In addition the Silviculture division has participated in a number of elaborately conceived long-term all-India experiments drawn up and directed by the Central Silviculturist at Dehra Dun, as, for example, the optimum treatment of bamboo clumps, the comparative development of teak of different origins in each province and, on the statistical side, the laying out of linear sample plots—many dozens of miles of them—for studying growth in irregular forest. Every year, moreover, large numbers of permanent sample plots, of which the province maintains 3—400 of different species, are re-measured and new ones laid out in co-operation with Dehra, while provisional volume tables, *e.g.*, for *haldu* and *banj* oak have been prepared as local demand requires. The Silviculture division, in consonance with the trend of the times, also co-operates with the Development Officer in establishing demonstration plantations in plains districts and has recently busied itself with the propagation of better fodder grasses, including numerous exotics.

Finally, although not strictly research, another activity entrusted to the Silviculturist of considerable interest to all forest lovers deserves mention, the more so, perhaps, because it is devoid of all commercial bias—namely, the creation of "Preservation Plots" and "Protected trees." This movement, which began in 1936 aims at preserving for all time various representative forest types in their natural state, as also fine specimens of tree—a step that, in view of the increasing intensity of working throughout our forests, was taken none too soon. To date, 25 plots have been preserved, varying in extent from under an acre to over 100 acres, while about 120 fine specimens of trees of various species and scattered over a dozen divisions are now saved for posterity, and the list is being added to every year.

MISCELLANEOUS

1.—Forest Conservation in the Kumaon Hills

This difficult problem, of vital importance to the whole province—and, indeed, beyond it—has during the period under review given rise to ever-increasing anxiety; an anxiety that has finally spread to the very folk whose improvident habits have occasioned it, if not to the politicians who gave them backing. Fifteen years is no

long time for creating a forest but it easily suffices to destroy one. Up to 1925 the department had the management of some 3,500 square miles of reserved forest, including 200 square miles of "Old Reserves" dating from the previous century, spread over the middle and upper Himalayas, the whole constituting a magnificent and precious forest estate in a key region of the province. In that year, as a result of local political agitation, and with grave misgivings repeated and elaborated in many a report since, the Forest Department saw 60 per cent. of these reserves, most of them protecting important catchment areas, wrested from its control and thrown to the Kumaonis' axe and beast and torch. While 168 square miles were disforested outright, no less than 1917 square miles were relegated to the nominal control of the Civil authorities for unrestricted exploitation by the people. A few negligible safeguards did exist on paper but there was neither the knowledge nor the staff to see these properly enforced.

These surrendered forests, designated with unconscious irony as "Class I Reserves," formed the subject of an anxious departmental survey as early as 1933 and the depressing catalogue of destruction thus revealed, particularly in the fodder-yielding and soil-sustaining oak belt, has long since been eclipsed. Even in the "Class II" reserves remaining to the department it was decreed that no oak could be protected, browsing and grazing were unlimited and free to all and the only reserved species occurring in commercial quantity, the *chir* pine, remained at the mercy of uncontrolled firing from the nearest Class I forests and of any Kumaoni nursing a flintbox and a grievance. Indeed, if any hoped that these wholesale surrenders of priceless public property would effect a respite for what forest remained to the department, they were speedily disillusioned. The horrible holocaust of 1921 was repeated exactly ten years later when incendiary fires swept 40 per cent. of the entire regeneration area in the hills; was barely forestalled in 1936 and recurred in full force in 1939, when 30,000 acres of regeneration were again ravaged and thousands of maunds of resin destroyed.

The G.O. permitting this anarchical state of affairs, No. 895 of 1925, did provide for recuperative closures in both classes of reserve but over a period of fifteen years not an acre was closed by the Civil authorities controlling Class I forest and, warned by bitter experience,

only the barest minimum by the Forest Department in Class II, chiefly for essential fodder or fuel preserves and the worst cases of ruined reproduction. Up to 1940 less than 24 square miles had been closed in pathetic little patches all over Kumaon, offset by 4 square miles opened in compensation: hence a mere 1½ per cent.—less than 20 square miles—of the entire Kumaon Circle has remained protected from the hordes of hungry hill cattle and goats, estimated at over one million head, that press so sorely on the impoverished forest floor.

In this dismal prospect the gleams of comfort are few and some seem illusory. The limited area of Old Reserves which lie nearest to and supply the main centres of population—townships and cantonments like Naini Tal, Ranikhet, and Almora—has as yet suffered little from "popular" interference and remains the last standby of proper forest conservation. If right-holders have, since 1931, been conceded unlimited free grazing, at least the deadly browser is forbidden and all timber rights have still to be indented for; while the clamant need for oak-leaf fodder has been met by opening blocks in rotation to *hand-stripping,* a frankly compromise measure still in the experimental stage. In the far-flung Class II reserves, the only control short of closure left to the department has been directed against the pressing and formidable fire danger, which is being partly countered by careful slash disposal and considered schemes of controlled cold weather burning on an extensive scale. In 1940-1, for example, some 480 square miles were thus treated at a cost of Rs. 7/8/- per square mile. But with staff and money inadequate for full supervision, these burnings sometimes cause considerable damage; and they can do little towards protecting our prime care and responsibility—the fire-tender regeneration. Against unlimited grazing and browsing—in places so intense as to inhibit regeneration—and the reckless destruction of oak and other hardwoods the department has had no remedy or palliative, feeling itself helpless until public sentiment should show a definite change. Evidences of such change have fortunately not been lacking of recent years, in the form of mass petitions for protecting specific ruined areas, although such petitions, it may be noted, never recognize or choose to ignore the imperative necessity for some limitation on grazing and, above all,

browsing. The boomerang effect of wanton exploitation on village life has undoubtedly constituted the chief educator but the part played by the Forest Panchayat movement must also be mentioned. This movement which Government began tentatively in 1929 under a single Panchayat Officer, aims at forming villages into committees for protecting and managing their local forests, essentially in Class I and the remnants of old civil forest. With little or no staff—the Panchayat Officer for years played a lone hand—a vast and mountainous area and village co-operation notoriously lacking, progress has remained slow and uncertain. The decade's showing is 273 village committee controlling 73 square miles of forest, but in the absence of supervisory staff and compulsive powers it is questionable whether even such meagre results as these possess more than paper validity. With the appointment of 4 Forest Inspectors this very year and Sub-Divisional Officers invested with the powers of a Panchayat Officer, fresh impetus to the movement may be hoped for. Of more promise, probably, are the so-called "lat" panchayats, a parallel but indigenous conservation movement on private village land, which is already showing visible results in many an upland valley; nearly 450 of these self-created forest committees have been reported to date and their success may prove catching. When all is said and done, however, no government can afford to wait indefinitely for communities to learn wisdom from their folly, particularly when such folly affects other and far larger populations, and the recent turn of opinion in Kumaon has emboldened the authorities to intervene. The provisions of G.O. 895 have been somewhat tightened up and concrete proposals for protecting large blocks of ruined forest, both in Class I and Class II, are now being submitted to Government after consulting the leaders of the people, as represented on the Kumaon Forest Committee. The Kumaoni learns his lessons hard and despite exceedingly liberal rights and concessions, unmatched elsewhere in the province, he is going to feel severely pinched after nearly two decades of unbridled exploitation; but at long last, there is justification for feeling, the wheels of forest policy are turning once more in the right direction, to the ultimate and enduring benefit not merely of Kumaon but of the whole Gangetic plain.

2.—*Game Preservation and Preserves*

With the passing of the years, bringing increased pressure of population, more and more gun licences and the marauding motor car, our Reserves have become to an ever greater degree the last refuge of wild life, particularly the bigger mammals, in this province. Only in the Kumaon hills, where neither the shooting rules nor conditions of perpetual firing, grazing and hacking afford much protection to animals, has the stock of game seriously declined. There the Department has had to content itself with its trout hatchery activities, which it has prosecuted with increasing success; stocking the main waters of upper Garhwal, notably the Pindar valley system, first from Bhowali and then (1929) from new and more central hatcheries at Talwari, until the latter were closed in 1938 in favour of the by then fully stocked Gohna Lake, which now forms a natural reservoir for fry in the heart of the trout-fishing district.

On the preventive side, the high rewards—at one time Rs. 40/- per head—offered for wild dog, which vies with the commercial poacher as the most formidable menace to our game, have in the past decade reduced its numbers to negligible proportions. On the other hand the strict protection so long extended to wild elephants —the last *khedda* was held before the 1914 war—has resulted in their multiplying to an embarrassing extent, particularly in the bamboo forests of Lansdowne Division where their number is said to exceed a hundred. A limited number are now to be shot so that forest and especially plantation work may be less interfered with.

The Department has also played its part in tightening up the Wild Birds and Animals Protection Act in its application to the U.P. (1933), so that killing, capturing and selling of game in the close season and the netting of most classes of game birds are now cognizable offences: but public opinion has still a long way to go before such measures can be said to have the backing and co-operation of the common people.

The most important development of the period, in relation to game preservation, was the passing of the U.P. National Parks Act (Act I of 1935) under which some 122 square miles of the outer Siwalik foothills in the Ramnagar and Kalagarh Divisions have been declared a permanent game sanctuary, called the Hailey National

Park. The locality is a wild and rather remote one but much has already been done to increase and improve rest-house accommodation and roads, and the Park can now be visited by car from both Naini Tal and Delhi throughout the dry season. A temporary sanctuary has also been made since 1935 of the popular Kansrau shooting block (30 square miles) in that Mecca of shikaries, the Dehra Dun Division, to the obvious benefit of the wild life there.

(*Concluded*)

STORAGE OF FOREST FODDER AGAINST SEASONS OF SCARCITY

By V. S. Krishnaswamy, M.A., I.F.S.

[Being an expanded English version of a radio talk in Tamil which was broadcast on 13th December, 1941.]

Out of a total cattle population of about 25 millions in Madras Presidency, nearly 1.5 millions depend on the reserved forests for their fodder. This number, in most districts, does not include the valuable bulls used for agriculture and cows under milk, which normally are not taken out to the forests for grazing, but are fed mostly on fodder available in the villages, like straw, crop residue, hay and concentrates like oil-seeds and *poonac,* supplemented occasionally by cut green fodder from the reserves. Thus while the ordinary ryot makes some arrangement to feed the cattle of immediate use to him he is callously negligent about the rest, which have to depend entirely on the reserves for their maintenance. All he does is to buy annual grazing-permits for them, costing about 3 to 4 annas per cow and turn them into the forest to eke out their miserable existence. This callousness in a country where cows are worshipped is certainly regrettable.

Forest grazing is notoriously seasonal corresponding mostly to monsoon months, say from July to January. After February only dried over mature grasses of low digestibility and still lower protein content are available in the reserves. This should not be confused with hay, which is cured from grass, cut slightly earlier and is richer

in proteins and starch equivalents than this aftermath. This aftermath will be useful only as a roughage and is scarcely rich enough to maintain the condition of the cattle. The grazing grounds thus become mere exercising grounds and even this dried fodder will disappear later on in summer, when forest fires do occur. No serious attempt has been hitherto made to overcome or reduce the rigour of this scarcity of cattle fodder in summer months. This is an annual problem.

In the ceded districts of the presidency which do not lie definitely in either of the monsoon zones, the rains fail in some years and acute scarcity and distress occur then. Even the little amount of cattle fodder, which the ryots expect from their fields for their useful cattle, will no longer be available and the reserved forests have to bear an additional burden. These are the problems and the first step towards their solution lies only in the timely conservation of cattle fodder, availabe in the reserved forests of our presidency.

An examination of the forests will reveal that the cattle are not able to utilize all the pasture available in the reserves during the monsoon months when grasses grow. Great quantities of fodder will then be available, which if conserved at the proper time and stored, can be utilized during periods of fodder scarcity, like the summer months and famine periods.

Before considering the different methods of conservation at present known, it will be useful to know the changes in the food value which occur as the plants grow up. Generally speaking all crops are richer in proteins and in all nutrients when in their young stages of growth. This is particularly so with grassland herbage, which is a highly concentrated foodstuff in its early days of active growth, as the protein is high and the fibre low. Again the mineral contents and vitamin potency of plants become poorer as the plants become older. These facts have to be borne in mind, when appreciating the different methods of conservation of forage at present adopted.

Forest fodder which is primarily grassland forage, can be conserved either by drying it naturally or artificially, or by ensiling it. If it is dried naturally it is called hay; if artificially it is called dried

grass. At the outset it must be stated that all these methods of conservation are complementary and have definite places in the economics of cattle feeding.

The chief operation in making hay is the evaporation of the water. The rate of drying is slow, since it depends on the relative humidity of the air and, normally, considerable changes occur during the evaporation stage. The cells are alive and respire throughout the drying period. During respiration, the most digestible fractions are utilized first, and the carotene is oxidised fairly quickly and almost completely, reducing the vitamin A potency to an extremely low level. The nutritive value must and does suffer as a result of the natural drying process. Further, the mechanical losses affect the most valuable leafy parts of the crop, whilst leaching by rain removes the most digestible soluble parts. In addition, the respiration and fermentation processes take toll of the digestible portions of Nitrogen free extractives. Loss of feeding value is thus high in hay making, since only the most digestible part of the plant is lost.

In artificial drying, the changes are negligible, since desiccation and death of the cell are relatively rapid. Consequently, there is very little respiration and the losses of digestible portions and carotene content of the grasses are negligible. Further mechanical losses, fermentation losses and loss by leaching by rain do not occur in dried grass. But subsequent storage of this product is a matter of importance. Poor storage will involve loss of colour and vitamin A potency. The oxidation of carotene must be avoided and boiling is one of the simple ways of minimising this.

The next method of conserving the forage is by ensiling it. Silage is the name given to the succulent material produced by a process of controlled vital changes from a green crop or other material of high moisture content. The storage of materials in a silo, either as grain or as a green crop has been common practice for many hundreds of years. The simplest case is that in which the crop is cut and transported to the container and carefully packed therein, steps being taken to exclude air as completely as possible. The temperature of the mass usually varies, varying with the efficiency of exclusion of air. After a suitable time has elapsed, usually about three months, the material is fed to the animals, and if it has been

made well it should be palatable and harmless to the cattle. The most obvious changes as compared with the original crop are change in the colour of the material, variable in depth from a light-brown to almost black and the development of a distinctive odour, which may at first repel the cattle. But after sometime the cattle take to it and when once they take to silage they do not leave it. A good silage requires: (*i*) restriction of the amount of air in the mass; and (*ii*) rapid increase in the acidity of the mass to such a level, that undesirable fermentations are suitably controlled. The aim should be to keep the temperature down to a reasonable level so that the digestibility of the silage might not be affected and the carotene content might not go down.

Rapid acidification of the mass is an essential feature of good silage. In ordinary silage, the acidification is brought about by the action of lactic acid and it is essential that the formation of lactic acid is stimulated. Since the lactic acid is formed from sugar or other fermentable carbohydrates, the crop should contain an adequate supply, if the acidity is to reach the required level. This accounts for the cutting of the crop for silage at a comparatively advanced stage of growth and also shows why crops like *sorghum*, rich in sugar, are such satisfactory crops to ensile.

Low temperature fermentation processes in which the mass reaches about 100°F have proved very satisfactory for grassland herbage. It is the most practicable and does not call for any special equipment. The details regarding the formation of silos and making silages can be obtained from the nearest Forest or Agricultural Officer. The following points, however, will be useful. Silage should be made in layers from freshly cut material, the course of fermentation being controlled by the rate of filling. It is particularly important not to build too fast for the lowest layers, but the rate can be accelerated with height. All silage should be weighed and where practicable sealed off as soon after filling is completed as is possible. Overmaturity of material should be avoided.

Stimulation of lactic acid fermentation presents a ready means of controlling changes in the silo, the dominant factor being a rapid acidification by the lactic acid organisms. Sugar is the most efficient substance to be added and is best given as a solution of molasses.

This should be added at the rate of 1 up to 2 or even 3 lbs. per 100 lbs. of green crop, increasing with the protein content of the crop. Thin layers must be filled in, with the usual precautions and each layer is sprinkled with a solution of molasses (1 of molasses to 1 to 2 of water).

Successful silage should not lose more than one quarter of the nutrients in the fresh crop and loss of digestible crude protein should be much less than this.

Of the three methods of conserving fodder, described above, from the point of view of losses of nutrients, artificial drying is the most efficient process and hay making, whether with special appliances or not, is the worst. Ensilage holds an intermediate position, the modern adaptations of the process being particularly useful methods to employ. Hay is as usually produced a roughage, and is mainly used to make up bulk in the ration, particularly of the most productive stock. But hay made out of younger grasses or crops has a relatively higher protein content and starch equivalent. The field-curing of such younger grasses and crop have to be done with special care. One cannot always depend on manufacturing such superhay in our presidency since rains may interfere with the drying. But such hay can be and has been produced, during breaks in rain in the Forest Grazing Station in the Coimbatore North Forest Division. Artificially dried crop and silage may be produced with a very high nutrient content capable of replacing concentrated foodstuffs in the ration of highly productive stock. But artificially dried crop requires costly apparatus to manufacture and good sheds for storing them. It may well be left out of consideration in our presidency as it will be beyond the means of most. Silage does not involve any heavy expenditure on apparatus. Mostly pit silages are made in our presidency, though this method will be unsuitable in districts where the subsoil water level is high, for example in delta districts. In such districts a simple portable wooden silo is indicated, but as far as it is known it is a new thing for India. A suitable type of wooden silo has been devised by the Imperial Chemical Industries and a dimensioned sketch of it, with working details can be got from the firm. But silage being a succulent fodder cannot be transported over long

distances without deterioration and expense, whereas hay, which has a low moisture content can be baled and transported over comparatively long distances at low costs.

The most important point to impress on the agriculturist is the necessity for becoming conservation-minded. Experiments in which direct comparisons between hay, the artificially dried grass and silage have been made, reveal that all the three will produce effects which can be predicted from their composition and digestibility. In hay, the ryot has a roughage which will be useful as the maintenance ration for less productive cattle and also a supplementary feed to make up bulk for the most productive cattle fed on concentrates. It must be mentioned here that cattle cannot live on concentrated foods alone even as human beings cannot live on tabloid foods, for bulk is essential if the physiological functions of the digestive systems are not to be ruined. In silage, the ryot has a more productive food than hay, since it can replace concentrates. It is clear, that the potentialities of the grasses found in our reserved forests are not now exploited to the full. If the ryot wants succulent and concentrated fodder he can ensile the surplus grass at any time and store it in the silo itself until it can be used to greater advantage, thus preventing the considerable waste which takes place every year on most of our grassland. If he wants bulk fodder he can make hay though he cannot do it at all seasons of the year. Its manufacture is restricted to a small part of the growing season when the crop is approaching or past maturity and when rains will not interfere. There is considerable surplus of grass in our reserves, during the rainy months and why should this be wasted and left probably to be burnt when it can be ensiled as nutrient fodder or made into hay for use later on in summer months, when such fodder will not be available in the reserves? Ensiling the crop at a relatively early stage of growth would greatly increase the protein content and general feeding value of the product and still allow of subsequent growth which could in turn may be made into good hay. The value of silage is particularly great in our presidency, where climatic conditions result in a rapid maturing of crop, with a consequent marked increase in fibre and decrease in general feeding value. Further, the silo is both the fermentation chamber and the store for the products. The ryot need

not construct costly sheds for storing them, a valuable consideration for the ordinary ryot.

According to experiments conducted at the Agricultural Research Station at Pattambi 100 lbs. of good silage can be made at a cost of Rs. 0-2-8 to Rs. 0-3-0 and on an average, 1,000 lbs. of silage per mensem might be necessary per head of cattle.

Silage is known to preserve well. Recently, when a silage pit was opened after 18 months, the silage was still good and palatable. This fact can be easily utilized for the benefit of cattle in times of famine which often occur in our ceded districts. Silage has a great value in such times of drought as succulent fodder; the difficulty at such times is not only one of nutrients; the lack of water is often more serious. A battery of silos can easily be formed in districts susceptible to famine, as a fodder reserve, quite apart from the summer reserve. The silage thus preserved will supplement the forest hay, supplied at present by the Forest Department to the valuable agricultural cattle in times of drought. If famine does not occur, the silage can be given to the cattle as supplementary rations during the rainy seasons and if it has been made out of young succulent blades, can very easily be substituted for concentrates like *poonac*, etc. The possibilities are thus immense and this method of reducing the distress of cattle in times of famine is strongly recommended.

The full potentialities of silage have not been realized by our ryots. In the first place, it is more even in composition than artificially dried crops, in view of the greater speed with which the crop is cleared. The addition of inorganic Nitrogen to silage is a distinct possibility. It is a simple method to add Ammonium sulphate, Ammonium bicarbonate or Urea, in solution with molasses. This has been done without any loss of quality in the resultant product. About 5 lbs. of Urea or 10 lbs. of Ammonium sulphate per ton of grass would bring about an increase of 2 lbs. of assimilable Nitrogen, per ton of silage.

Another useful possibility with silage is the correction of mineral deficiencies in the herbage and this can be done with ease. To correct phosphate deficiency, Ammonium phosphate may be added during silage making. This has been done with success, the final product being a perfectly normal sample of satisfactory silage with in-

creased Nitrogen and Phosphorous content. Calcium can be similarly added as Calcium chloride. In districts where deficiencies of a minor element occur, silage is again a valuable vehicle for that addition; the element in question has only to be added in soluble form to molasses solution at a predetermined rate and will be sprayed on at an even rate throughout the silo. If a metallic oxide is to be added, it would be transformed in the silage as the acetate or lactate, which will be readily assimilable.

In addition, of course, silage possesses as high a vitamin value as any other product of conservation. The time has surely come for a wide expansion in the use of silage. It is the first approach to conservation and putting the economics of the farm on a sound footing. In an essentially agricultural country like ours it is certain that in the intensified conservation of surplus grassland herbage of our forests the solution lies to many of our major agricultural and national problems.

AN EXERCISE IN SILVICULTURE

By F. Allsop

In Insein Division, Burma, there are 75 square miles of very accessible plain reserves occupying flat or mildly broken country along and touching or almost touching the Rangoon-Prome railway line. Their average distance from Rangoon is about 50 miles. The average width of the reserves, which are continuous with the main Yoma Hills forests, is about 5 miles.

They have been worked actively and on sound lines for the Rangoon market and for village supply for nearly 40 years, since Rorie wrote the simple but successful Working Plan under which they were managed from 1905 to 1925.

The main features of Rorie's prescriptions were retained in Scott's 1927—37 Plan, but certain improvements were introduced, and in particular special experimental markings on intensive lines in selected whole compartments were prescribed. These gave excellent results, so at the further revision of the Plan in 1937, the markings described below, based on the experimental work of 1927—37, were introduced as a main feature of the management. The first

two of the three stages of marking are simple enough but the "regeneration markings" present features which are possibly of general interest in view of the balance between the silvicultural and utilization aspects which must be preserved when carrying them out.

These regeneration markings are preceded by girdling of teak, of which there is only a little, and a marking, three years later, of all other species on appropriate girth limits, a purely mechanical operation done by foresters. The term "exploitation marking" is used in the plan to describe this mechanical marking. When all girdled teak and trees over the girth limits have been felled—but not necessarily extracted—the regeneration marking is carried out with the object of assisting existing growth by removal of worthless trees interfering with more valuable ones, by freeing groups of advance growth and by thinning amongst pole crops, etc., and of inducing new regeneration by opening the canopy. The cutting of all climbers and felling of *ficus bound* trees is an essential adjunct to the operation.

The forests are principally of the lower mixed deciduous type containing *Xylia dolabriformis* (*pyinkado*) (of moderate quality), *Homalium tomentosum* (*myaukchaw*), *Anogeissus acuminata* (*yon*), *Mangifera indica* (*thayet*), *Adina cordifolia* (*hnaw*), *Mitragyna diversifolia* (*binga*), *Schleichera trijuga* (*gyo*), a little *Lagerstrœmia flos-reginæ* (*pyinma*), *Lannea grandis* (*nabe*), *Terminalia chebula* (*panga*), *Anthocephalus cadamba* (*ma-u-lettanshe*), *Sterculia campanulata* (*sawbya*), *Bombax insigne* (*didu*), *B. malabaricum* (*letpan*), *Vitex peduncularis* (*petlezin*), *Careya arborea* (*bambwe*), *Dillenia pentagyna* (*zinbyun*), *Lagerstroemia tomentosa* (*leza*), *L. villosa* (*zaungbalwe*), *Bridelia retusa* (*seikchi*), *Cassia fistula* (*ngu*), *Carallia integerrima* (*maniawga*), *Pterospermum semisagittatum* (*nagye*), *Grewia microcos* (*myatya*), *Terminalia belerica* (*thitsein*), *Dolichandrone stipulata* (*mahlwa*), *Heterophragma adenophyllum* (*petthan*), *Sterospermum* spp. (*thakut* and *thande*), *Diospyros ehretioides* (*aukchinsa*), *Strychnos nux-blanda* (*kabaung*), *Aporosa* spp. (*yemein*), *Phyllanthus emblica* (*zibyu*), *Croton oblongifolius* (*thetyungi*), *Walsura robusta* (*gyobo*), *Spondias mangifera* (*gwe*), etc., with some evergreen containing *Dipterocarpus* spp. (*kanyin*), *Pentace burmanica* (*thitka*), *Anisoptera glabra* (*kaunghmu*), *Hopea*

odorata (*thingan*), etc., and some *Dipterocarpus tuberculatus* (*in*), more or less gregarious, with an occasional *Shorea obtusa* (*thitya*) or *Pentacme suavis* (*ingyin*), but usually mixed with other species to such an extent that it is called locally "semi-*indaing*." "*Indaing*" is the name given to the pure crops of *Dipterocarpus tuberculatus* very common in Burma on certain soils.

Owing to their very favourable situation with regard to Rangoon and a heavy local population and their great accessibility, utilization of this very complex mixture is almost complete.

For the Rangoon market timber is obtained principally from *pyinkado*, *yon, kanyin, thitka, in, binga, thayet, maniawga, thabye,* and matchwoods (*ma-u-lettanshe, sawbya, didu* and *letpan*), and firewood from *myaukchaw* and almost any other species. The relative values of the various classes of firewood are:

Myaukchaw	... ...	100
Pyinkado (lop and top and defective trees)		80
Gyo and *yon*	... ...	55—60
Taukkyan and miscellaneous mixed species		40—45

Most of the very large quantity of firewood produced is sent to Rangoon.

For local markets the most prized timber species are *pyinma, thitka, hnaw, Terminalia tomentosa* (*taukkyan*), *leza, petlezin, zinbyun, nabe, panga* and *banbwe,* but almost everything, including such poor species as *aukchinsa, Terminalia pyrifolia* (*lein*) and *thitsein,* is cut up in local saw-mills if obtainable in logs of reasonable size and shape. Some of this is undoubtedly passed off in Rangoon under the names of better timbers with somewhat similar appearance.

The method of sale is by auction at which the bids made for each coupe represent the premium payable for the right to work: royalty on the timber and firewood actually extracted is charged at the rates notified for the unclassed forests. The premia realized usually exceed—often by a considerable amount—the total royalty received and are based on the proportion of the more valuable species in the coupe.

The best prices are obtained for coupes containing relatively large quantities of *pyinkado, myaukchaw, kanyin, yon gyo, in thitka,*

thayet, hnaw, binga and matchwoods, approximately in the order named, and this must therefore be the order of preference when considering which trees are to be favoured during regeneration markings. This list is a long one and the work is further complicated by the necessity for taking into account the future prospects of a tree it is desired to help.

Generally speaking a tree likely to yield timber, even of the cheaper royalty-classes, is more valuable than one that will only produce firewood, but *myaukchaw*, and perhaps *gyo* and *yon*, are sufficiently attractive as firewood to put up the premium value of a coupe high enough to compensate for the low royalty payable for firewood. The marking officer often finds himself forced to make an estimate of the relative value 30 years hence of trees of the most valuable species, which have suffered from suppression and climbers for some years, and trees of less valuable species nearby which have managed to avoid these setbacks. It is obviously inexpedient and wrong to remove a tree of low royalty-value which will almost certainly provide sound straight timber at the next felling cycle in favour of saplings of the most valuable kinds which have still to overcome the dangers of adolescence.

There are countless cases in which there is a great deal of scope for judgment. It has to be realized that *myaukchaw* and *gyo* are cut up into short billets and it is not essential for them to be straight-grown, that *kanyin, pyinma, thayet, binga* and *hnaw* are almost useless unless well-grown, *yon* and *taukkyan* are reasonably valuable whether straight or crooked, etc.

The Working Plan rightly prescribes that regeneration marking be carried out by gazetted officers—and the work demands the best from them. It is essential that the officer in charge knows his trees well and, in the rich and well-stocked areas where most good —and most harm—can be done, that he can clearly and quickly think out each problem as it is presented to him.

Marking is carried out down to a minimum girth of 2 feet 6 inches and all dead and fallen are marked and recorded. In the past there have been numerous cases of manufacture of "naturally dead" trees in the Insein plain reserves and now extraction is

restricted to "marked and scheduled" windfalls and naturally dead trees.

The marking officer must, of course, cover the ground very thoroughly and his report includes a stock-map and a description of the growing stock in each compartment.

At the time of regeneration marking all ficus-bound trees are felled and all climbers cut, but experience indicates it is advisable to do both these operations during exploitation markings and this will be tried shortly. Ficus-*bound* trees are marked and recorded, traders often taking the enclosed tree and sometimes even the *ficus* as firewood. It is essential to fell departmentally—otherwise traders are liable to fell them on top of valuable trees and ask permission to take the damaged tree.

When the extraction of exploitation markings—in which all marked trees are obligatory—and regeneration markings—in which they are optional—is complete, cleaning is carried out to remove trees of valueless species below 2 feet 6 inches girth interfering with more valuable ones, to fell all marked trees left by the extraction agency and all *gwe* trees, which are plentiful and of too little value to be marked for traders, and to coppice damaged and misshapen stems of valuable species. This costs about Re. 1 per acre but the results obtained show the greatest promise and it is considered there is every prospect of this expenditure yielding a very handsome return.

CONTOUR TRENCHING VS. IRRIGATED PLANTATIONS DE NOVO DE NOVO

A REPLY

By W. D. M. Warren, I.F.S.

Summary.—The amount of runoff water, which can be held up for the benefit of a forest crop is only limited by the size of the contour trenches, the intensity of the rainfall, and its annual total. In regions of fair rainfall, the extra amount which can thus be held up, is much greater than the amount ordinarily available for irrigated plantations in arid regions, owing to severe competition with agricultural crops. In these circumstances and also owing to their more favourable environment, contour trenched forests are likely to be, on the average, more luxuriant and more efficient as focal points for moisture condensation.

I was very amused at the note written under the title *"De Novo de Novo"* in the *Indian Forester,* dated September, 1941, by *"Non*

Compos Mentis" (N. C. M. for short). It is extraordinary amount of fun which the contour trenching and its believed climatic influence is producing! All sorts of people are sharpening their wits on it including budding poets!

N.C.M. seems inclined to challenge my statement that the Singhbhum forests are nearly 100 miles across—my chief point, however, is that they and the Keonjhar forests are together more than 100 miles long, so I do not propose to argue how near to the 100 miles the Singhbhum forests are in length.

N.C.M. enquires "Would irrigated plantations of the Punjab not constitute more efficient focal points than the dry trenches of Bamiaburu?"

Environments utterly different

The answer is that the two places have so little in common that they can scarcely be compared at all! The Bamiaburu area lies in a comparatively moist belt of forest-clad hills only 150 miles from the sea. Winds passing over or drawn in from that direction are therefore fairly easily deprived of their excess moisture by both the condensing agencies, hills and forests, to give a useful rainfall of 50—70 inches annually.

The Punjab irrigated plantations, on the other hand, situated in the plains one thousand miles from the sea, lie in a huge dry tract of land, extending from the Sind Desert to the Himalayas in the one direction, and across Baluchistan into Iran in the other. This belt gets so hot and exerts such a powerful cyclonic influence for 3-4 months every year that it causes the monsoon rains from June to September to blow from the South West (with indraughts from the Bay of Bengal from the South East) in a contrary direction to the usual North-East Trade Winds. And yet these moisture-laden winds by the time they reach the Punjab are usually dry, having been robbed of their misture by the Western Ghats of Bombay, the Central Indian Hills and the Himalayas. Being hot these tracts also have a much greater capacity for holding moisture without precipitating it.

For example, even now, in the month of September, temperatures there apparently reach 100°F or more, so much so, that the

other day the fact that no station there recorded temperatures of more than 100°F, was of sufficient significance for the Delhi radio announcer to mention it. Our temperatures at this time rarely exceed 90° F, so that the Punjab's capacity for holding atmospheric moisture is at least 25 per cent. more than Singhbhum's. No wonder Punjab gets no regular monsoon rain, and Lahore's average rainfall is only 17 inches!

Consequently, although these Plantations as moist focal points in a huge hot dry tract exert with it infinitely more influence for drawing in winds from all directions than do the Singhbhum forests, yet their ability to condense moisture in such adverse conditions is severely handicapped, quite apart from their comparatively small size.

Bamiaburu forests the more luxuriant

There is another aspect to this question, however. N. C. M. evidently thinks that the irrigated plantations of the Punjab, if their adverse environment could be discounted, would be much more efficient as focal points, that is as moisture condensers than the forest influenced by the so-called *dry trenches* of Bamiaburu. (The italics are mine.) Is he right?

Now the efficiency of a forest in condensing moisture depends upon its luxuriance, age, density, size and proximity to the sea. Let us assume for the sake of argument that all the other factors are equal and that the only variable is the amount of water available to each. Which type, contour trench or irrigated forest, gets the most water, and so is the more luxuriant?

Rainfall equivalent of the irrigated plantations

The average annual rainfall at Lahore as already mentioned is 17 inches, and at Chhanga Manga only 13 inches. As the plantations are situated on deep alluvial level ground we can assume that the whole of this rainfall is absorbed. The irrigation system aimed originally at giving each plantation area twelve irrigation waterings between the months of May and October, with the equivalent of three inches of water at each watering or 36 inches in all. Had it been possible to continue with this plan, the Chhanga Manga plantations would now be receiving the equivalent of 49 inches of rainfall

from both sources—rainfall and irrigation—and the other plantations 53 inches. Nowadays, however, the demand for water for Agriculture is so strong that at Chhanga Manga, the Divisional Forest Officer informs me, it is only possible to irrigate half the area of older crops twice, and the other half once, with 10—12 irrigations for the regeneration area, and 4—6 irrigations for the younger crops. Presumably the same restriction applies to the other plantations. Thus the regeneration areas now get 49—53 inches, the younger crops 31—35 inches and older crops 16—23 inches equivalent of rainfall only.

Rainfall equivalent of the Bamiaburu contour trenches area

The average annual rainfall in the contour trenched area around Bamiaburu is about fifty inches. Based upon personal inspection of the Nurpur runoff experimental plots in the Punjab, on knowledge of their first year's runoff figures, and upon a close study of vegetation conditions on Kolhan's arid hill slopes, it is estimated that 50 per cent. of this rainfall at Bamiaburu formerly ran off each year. Since contour trenching began, the area below the trenches has so thickened with vegetation, that the runoff, again judging from the Punjab plots, must now be less than 10 per cent. In other words at least 45 inches of rainfall below the trenches are now being absorbed annually, and only 5 inches runs off. To this figure at first must be added 50 per cent. of the rainfall—the runoff—from above the trenches and held up by them. The total rainfall water which the area below the trench at first received would therefore be 45 inches plus 25 inches or 70 inches of rainfall, and the distance influenced to that extent below would be the length of the catchment area above, on the assumption that the trench was capable of holding up all the runoff. Areas near the trench of course would receive more water than this, and areas further away would receive less although the areas below always benefit considerably by underground seepage.

As against the equivalent of 16—53 inches of rain which the Punjab irrigated plantations receive, the contour trenched forests of Bamiaburu area therefore received an average of seventy inches, —a very useful amount. There can, therefore, be no question as to

which are the more luxuriant and the more efficient as focal points for moisture precipitation.

Subsequently at Bamiaburu the vegetation *above* the trenches has thickened considerably due to climatic improvement. This has lessened the runoff and helped to distribute the benefits over a larger area. How far this climatic and consequential vegetational improvement extends has yet to be determined, but that it is there and that it is considerable is revealed not only by the thickening vegetation, but by the four yearly average rainfall figures 1936—39, for Sonua, six miles away and three miles into the open. These figures and those for other nearby stations have just come in and will be analysed later. Those for Sonua are really remarkable, much better than I could have hoped for.

The irrigated plantations of the Punjab if they were surrounded similarly by forest, would also exert a climatic influence on that forest but that influence judged by the water it receives, would only be $\frac{16-53\text{ths}}{70}$ of that exerted by Bamiaburu for areas of equal size.

Contour trenches not dry

Why does N. C. M. in asking his question refer to the Bamiaburu trenches as being dry, the inference being that the trenches of the irrigated plantations are wet, by comparison? On the contrary from what has been written above one can shrewdly guess that the Bamiaburu forests being the more luxuriant with a greater supply of water would also have wetter trenches, and the guess would be correct as the following calculation shows.

The average number of rainy days of over .1 inches of rain at Bamiaburu is about 72, and presumably the trenches would get wet on each rainy day.

Lahore receives 17 inches of rain annually or roughly one-third that of Bamiaburu. We can, therefore, assign to it 24 rainy days. In addition the regenerated areas of the plantations are irrigated twelve times in each season, so that the trenches are wet for at least 36 days altogether each year, or only half the number of days that the Bamiaburu trenches are wet. The older areas get less irrigation waterings and so their trenches are wet for fewer days each year, moreover evaporation is more rapid there than at Bamiaburu. It

would be nearer the truth, therefore, to say that the Bamiaburu trenches are wet and the irrigated trenches are dry!

I have dealt with this casual question in some detail, because it is an echo of the debate which took place at the Bihar Forest Conference in September 1938. For twenty minutes, the question was wrangled whether the word "Irrigation" was an appropriate term to apply to the contour trench method of increasing the water supply. Those against using the word in this connection, argued that the trenches of the irrigated plantations were much more efficient and were more or less permanently filled with water. We see that this is far from being the case, and that in this respect at least the contour trench method of watering areas, worthily upholds the proper use of the word, as well as fulfilling the Dictionary meaning.

So another myth has been exploded!

WAR SUPPLIES FROM FORESTS OF PILIBHIT

By M. D. Chaturvedi, b.sc. (Oxon.) i.f.s.

Summary.—The supply of about a hundred thousand cubic feet of scantlings, three lakhs of sal poles, 40 thousand sleepers and timber for stretchers, tool handles and other needs of the Army, represents the contribution of the Pilibhit Forests in 1940-41 towards India's Defence. The extraction and transport of such vast quantities of timber presented problems as interesting as their solution was ingenious.

Lying snugly in the west Himalyan *tarai* of the United Provinces, the Pilibhit Forests, noted hitherto only for their wily and sophisticated tigers, were transformed into a scene of intense bustle in response to the demands of timber for Defence. Around the numerous camp fires one met sawyers from distant lands, axemen from the adjoining hills and lumbermen from villages close by. They hailed from places far and near and found employment at rates they had never known before. The exploitation, which in normal years was cofined to the few healthy cold weather months, began last September and continued apace till the break of monsoon without respite, let or hindrance, braving the vagaries of the weather and defying malaria for which the *tarai* is notorious.

The extraction of forest produce along unmetalled tracks must normally await fair weather. The exigency of the situation, however, demanded special measures. Necessity devised a novel road

Fig. I

Undaunted by rains and slush, the bullock and the buffalo negotiated tracks which seemed impassable.

Photo. By the Author.

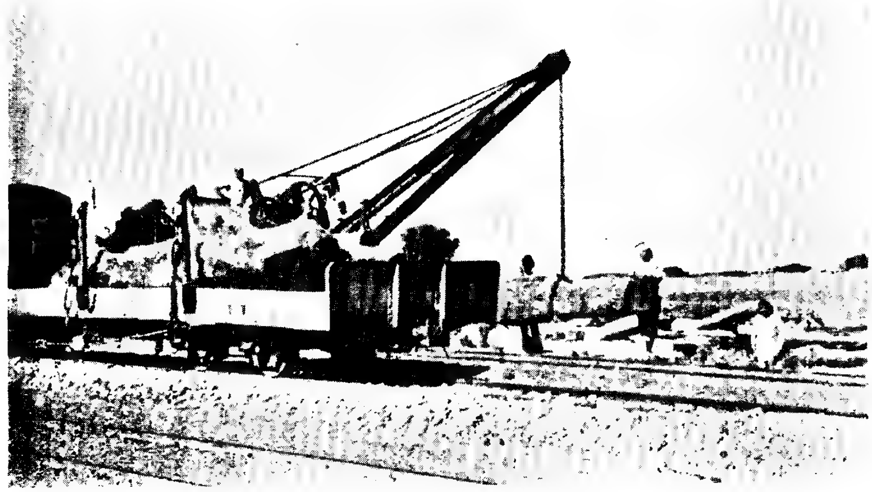

Fig. II

Moveable cranes dealt with heavy logs.

Photo: By the Author.

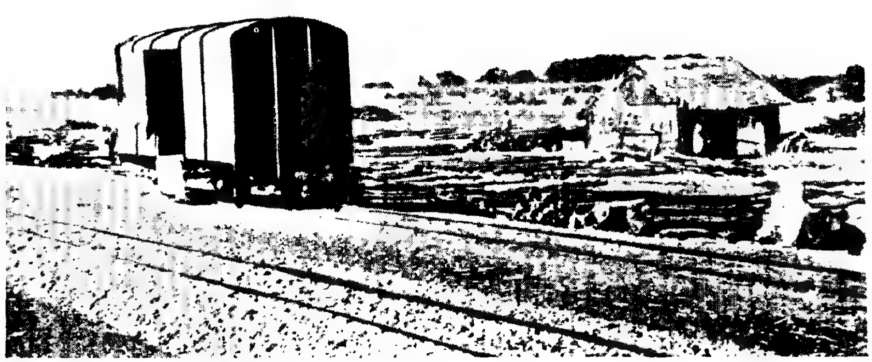

Fig. III

Tidiness in timber yards spelt efficiency.

Photo: By the Author.

surface obtained by spreading fellings, debris, slash and other refuse lying in the forests. With roads made into weather-proof rides, the extraction continued right through the wettest winter we have ever had. Undaunted by rains and slush, the bullock and the buffalo negotiated tracks which seemed impossible. (*See* Fig. I, plate 12.)

At the railheads, station yards were literally choked with lumber overflowing into adjoining lands. Little wayside stations were called upon to handle a volume of timber traffic for which they were frightfully ill equipped. Despite irritating delays and hold-ups caused largely by the scarcity of wagons and paucity of labour, the Railways reacted splendidly to the needs of the hour. Thanks to the marvellous organization they ultimately managed to evolve, the railways cleared over a thousand wagon loads of timber which went to house the expanding armies of India. (*See* Figs. II & III, plate 12.)

The Defence Supplies amounted to about a lakh of cubic feet of scantlings and three hundred thousand poles. In addition, timber was supplied for stretchers, tool handles, furniture and other needs of the Army. About 40 thousand sleepers went for replacements along railroads. This was not all. The increasing demand of the timber market caused by the substitution of iron by wood had also to be catered for.

The demand for timber for Defence was as heavy as it was sudden. It was, therefore, not without repercussions on the stereotyped management of forests designed to meet the normal needs of timber market. Advance fellings had to be resorted to. Operations hitherto uneconomic became possible, and new silvicultural technique developed in the light of special requirements. Taking advantage of the rise in timber prices, owners of private forests also lent a helping hand in relieving the pressure on our resources.

With the exception of a few temporary hands employed for the passing and checking of timber before despatch, the supplies were handled, in the main, by the existing permanent forest organization. Being erratic and importunate, the demand often strained our organization beyond elastic limits. The tension was, however, relieved by occasional glimpses of unconscious humour. A subdivisional officer insisted on being enlightened regarding the weight of each sal pole unmindful of the demurrage; another wanted all his

poles to measure exactly 6 inches in diameter. 'Boxed heart' and 'breast-height' raised many a laugh, and mid-diameter not a few enquiries. The terms *sal, chir, ballies* were treated as synonyms of poles. Wagons worked on ungreased axles without so much as a creak; while the cart-driver enriched his vocabulary addressed to his tired bullocks. But the best of all was the man who advocated a *lathi* and thought *ballies* to be too unwieldy for the purpose!

SAL REGENERATION *DE NOVO*

(A REPLY TO MR. JACOB'S REJOINDER)

By R. N. De, I.F.S.

I have read Mr. Jacob's rejoinder to my note in the *Indian Forester* for July, 1941. In my last article on sal regeneration (*Indian Forester,* June, 1941), as well as in the previous one (*Indian Forester,* November, 1937), I have given facts and figures regarding the experiments carried out by me over several years and conclusions based on these, as well as on observations made by me for over 15 years in the sal forests of Assam, Bengal and other parts of India. I repeat in brief the salient points in my note and these are that burning is not a *sine qua non* of sal regeneration and that given proper canopy condition, no sal forest, even if covered by evergreen undergrowth, is unsuitable for sal regeneration. I have searched the rejoinder in vain to find the results of any properly conducted and recorded experiments or observations refuting my conclusions.

I shall now take up Mr. Jacob's criticisms—

Quotations have been given from the Assam Annual Administration Report for 1915-16 to show that every effort was made to burn the forests of Kamrup Division and that it was completely successful. In reply to that I would draw attention of the readers to the annual form No. 15—Causes of forest fires—from 1915-16 to 1917-18 which shows that only 100 to 600 acres of forest got burnt accidentally and no burning was done by the Department. This will prove how far the contention of success of the burning is correct. I can state from my own experience from 1925 onwards that forest actually got burnt as best as it could, consequent on the abandonment of fire-protection

and the present-day method of pressing and burning grass early had not developed. These operations cost money and there is no point in opening up the forest and introducing grass by forced burning, unless a compartment is due for regeneration which we know we can establish *de novo* by weeding and canopy manipulation in a few years in any sal forest.

The fact that whippy regeneration is found in Kamrup which has been variously ascribed to grazing, grazing and burning and burning only, and other circumstances which have not been properly studied even to-day does not, in any way, prove that burning is a treatment for *de novo* sal regeneration. We have not got an experimental plot laid out in the sal forest in Goalpara where canopy manipulation has introduced thatch, but the sal seedlings in this area has not made much headway in 5 years, although some weeding is done every year. This will show how difficult it is to introduce sal regeneration in grassland according to our wish.

The sal committee visited Kamrup and Goalpara in 1933, when the Kamrup plan prepared by Dr. Bor had run for nearly 3 years during which period the late Mr. Milroy, the present senior and the junior Conservators of Forests, Bengal, were Divisional Forest Officers, but it was left to Mr. Jacob to discover that none of them carried out the prescriptions of the plan properly.

I have been charged for overfelling in Bamba block but it is entirely wrong. The fact is that marking and felling of sal or *kukat* in the P.B.I. of the Bamba block referred to had been completed before I even took over charge. Indeed, I was so much taken aback by the fellings of *Gmelina arborea, Amoora Wallichii* and other timber trees, which were removed in the name of so-called *kukat* felling, that I wrote up to Conservator about this matter. The Goalpara Working Plan came into force from 1929-30 and I took over charge in January, 1932, nearly 3 years after the plan had come into operation. If the critics had taken the trouble to see the records in the working plan file, they would have found to their surprise that I protested against making big gaps and it was during my time that such markings were put a stop to. As for removal of excess yield from the P.B.I., I may mention that ever since I took over charge, I have never had my full quota of yield any year due to overmarking

in previous years. At the top of it, sudden opening of the forest in those coupes resulted in many wind-breaks and deaths which I had to sell as dead wood and count against the yield for which again, the P.B.I. outturn figures swelled. It is absolutely incorrect to say that I removed more that what is laid down in the prescriptions. During my tenure of office in Goalpara for about 6 years, my division was visited by the Conservator of Forests annually. We had the privilege of two visits from two Inspectors-General of Forests (Mr. Blascheck and Sir Gerald Trevor), and one from the Sal Committee. None of them found out that prescriptions were not carried out as intended by the Working Plan Officer.

In para 236 of the Goalpara Working Plan written by Dr. Bor it is stated that slight opening of the canopy brings in the *delicate variety of thatch* best suited for sal regeneration. The implications of the words 'delicate variety' do not seem to be fully understood. It is short, light, and a distinct variety of *Imperata arundinacea* which cannot be grown wherever and whenever we like, nor it is a depauperised variety of *Imperata arundinacea,* as some imagine. It is found in small patches here and there, but its ecology is not yet fully known and I should be glad to know of *one single recorded instance* in which any one has introduced this light variety by canopy manipulation and or burning for *de novo* sal regeneration. It is one of my experiments carried out in P.B.I. which showed that the usual undergrowth sau (*Pollinia ciliata*), found in the *bhabar* sal tracts, is not replaced by thatch (*Imperata arundinacea*) even in 5 years, although annually burnt, whereas if the thatch be present with *Pollinia,* burning helps it to spread in the *Pollinia*. Delicate variety of thatch does not grow to any one's bidding, nor is it the common thatch (*Imperata arundinacea*). Champion's book—*Regeneration and Management of Sal*—gives a photo of the area at the time in page 61 (*vide* Bamba sub-type D2 (a) plate 22). Again, my broadcasting and line-sowing experiments after pulling out the *Pollinia* have made the restocking of the Bamba area with sal a possibility.

Grassland in Kamrup is getting choked with *Eupatorium* which allows the sal seedlings to germinate and grow for a time under it and when it is pulled out, a mass of sal seedlings is uncovered. In

such areas, the thatch is so light or non-existent that it need not be taken into account. It is only in pure thatch areas where nothing but burning is practised after canopy manipulation and no grazing or weeding is done that least progress has been made.

Much stress has been laid about my clean weeding in Goalpara and the weeding in Kamrup in which the thatch is left alone. These are, after all, matters of detail, but the fundamental fact is that weeding must be done. In Goalpara, I purposely carried out my experiments in areas without any thatch, as the Working Plan Officer thought that such areas were unsuitable for sal regeneration and the question of weeding thatch did not at all arise. It is only when thatch began to come in after 2 years of my opening up the plots that thatch was also cut out with other weeds. My object of the experiment as recorded then was to find out if and when sal regeneration could be established by rains weeding and without burning under certain canopy conditions and these I published in the *Indian Forester* for November, 1937. *Let any one show even 10 acres of sal forest under observation in which 'de novo' sal regeneration has been introduced by burning and canopy manipulation without weeding, in the whole of Kamrup Division* during the currency of the last working plan (10 years). In his Inspection Note on Assam Forests Sir Gerald Trevor, Inspector-General of Forests, remarked as follows:

> Kamrup Division—
>
> During the past three years, however, every great attention has been given locally to this question of natural regeneration of sal and under Mr. Jacob, to whom greatest credit is due, very great progress has been made *chiefly from the uprooting of Eupatorium and rains weeding of the groups.*
>
> * * * *
>
> Bamba Block, Goalpara Division—
>
> In the above area (Amguri block, Haltugaon Division) by rains weeding, he (R. N. De) has obtained complete patch of regeneration. Similarly in Bamba by pulling out *sau* (*Pollinia ciliata*) in the rains, he has been able to obtain regeneration. One of his experimental groups 4 years old *is fully established.*

Laying out lines in opened up sal forests with *Pollinia* as undergrowth and supplementing the seed dispersal by broadcast sowings after pulling out *Pollinia* from the lines and subsequent rains weeding have been one of the experiments I carried out over about 15 acres in the Kachugaon Division. This went on for 2 years, and the seedlings were in whippy stage when I left the Division. This was a sequel to my previous experiment commented on by the Inspector-General as above, in which I pulled out *Pollinia* wholesale over 10 acres of forest with scattered sal trees and supplemented seed dispersal by broadcast sowing. The regeneration was profuse, but wholesale weeding was costly. This is why I took to line-clearing in my later experiments in order to bring down the cost. Recent Kachugaon Working Plan has adopted the principle underlying the experiments with the modification that weeding is done, but thatch is not weeded. In the latest Working Plan of the Kachugaon Division, not even a mention has been made of this experiment and the plot has been allowed to be smothered by weeds. It is said that the idea of pulling out *Pollinia* originated in Sajjanpara block of Kamrup Division. It would be interesting to the readers if any one would give the result of this experiment. As far as I am aware, no such experiment was either properly carried out or recorded.

As for the sal forests going towards evergreen climax without fire, I can cite the instance of our Bamba sal forests which were systematically worked for green wood only from 1929 and there are many forests in Bengal which are equally evergreen and yet I am not aware of anything in the soil condition which precludes the germination and growth of sal, either naturally or artificially, in such localities. What actually happens is that under a close canopy with evergreen undergrowth, seeds cannot germinate and seedlings cannot stand weed competition. Judicious opening up of the forest for light and reduction of weed competition are the only two conditions necessary for regenerating these forests when they are due for regeneration. It is absolute waste of money to go round the forest and try to force burning and change the vegetation from evergreen to grass and then go on burning *infinitum,* thus depriving the soil of its valuable constituents. As to whether repeated fire is harmful or beneficial will be apparent from the height growth, bole shape

and general healthiness of trees in areas that cannot be burnt. We know that we can induce natural regeneration in a sal forest when and where we need it in a few years' time by canopy manipulation and weeding. Why then this waste of time and money in trying to burn forests that are not due for regeneration? Although Troup wrote the remarks quoted by Mr. Jacob regarding cleaning in the Ripu Block of Goalpara between 1911-12 and 1914-15, the fact remains that sal seedlings have been established by me in my experimental plots only by weeding and gradual opening of the canopy in four years without fire (*vide* I.G. Forest's remarks above).

It is stated that Garo Hills Sal Reserves are subject to fire. I held charge of the Division for over 3 years and had been to most parts of the forest in different seasons. It will be to the interest of all concerned to know that those reserves were never burnt and there is no surprise about the natural regeneration being found in abandoned *jhums* and clearings in the forest where the seedlings had no weed competition and fire to destroy them. As for the natural regeneration of sal in the proposed Narengiri reserve, I may mention that I had seen Nepali *khutis* (graziers' camp) for 2 years and grazing has undoubtedly helped the establishment of the regeneration. In the southern part of the district, in Angratoli and other reserves, profuse regeneration is seen in grazed areas which were never burnt. In the Darrang Division, the sal forest has not been burnt as a routine measure and the undergrowth, if at all grass is not thatch but mostly *Arundinella* which is like short *Imperata*: Most successful patches of regeneration have been established here by weeding and fire protection. Similarly, fire played no part in *de novo* sal regeneration in the Nowgong Division as stated by me in my article.

Mention is made of places on the top of the ridges and Garbhanga block in the Kamrup Division where established sal is found, although no grazing has been done.* I am not aware of any burning squad ever visiting such places for early burning and it is not difficult to imagine that the sal regeneration has been established there under favourable conditions of undergrowth and *kokat* or bamboo

* Since I wrote the note, I have come to learn that the Garbhanga reserve in the Kamrup Division was also grazed in the past.

canopy. There are many such areas in Janali, Ripu, Ranga, Hel and other compartments of the Kachugaon Division where sal regeneration is found.

As forest officers, we all are interested in the problem of sal regeneration and it would have been more illuminating if the localities where opening up of the canopy and burning only have established sal regeneration *de novo* had been pointed out by my critics, so that others could see the achievement. *To take up whippy regeneration which already has come up under conditions that have not been properly studied and get them established is not solving the problem of sal regeneration 'de novo.'*

In para 96 of his *Annual Report of Forest Administration for Assam for* 1934-35, the late Mr. Milroy wrote as follows:

> "Within the last few years a coterie, as it were, has sprung up of officers of all ranks in Lower Assam whose energies are devoted towards solving of the problem of regenerating the sal forests naturally *i.e.* cheaply) it is a great pleasure to work with this band of enthusiasts, headed by Mr. R. N. De, Deputy Conservator of Forests, the like of which has not been seen before in the Forest Department in Assam."

Thanks to the lead given by Milroy, I have tried in my own way to follow in his footsteps and solve our problem of sal regeneration by laying out experimental plots and recording observations which alone can add to our knowledge. Forestry is not static and we are learning every day.

TIMBER PRICE LIST, JANUARY-FEBRUARY, 1942
(INDIAN STATES)
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Cochin ..	Logs ..	Re. 0-8-0 per c.ft.
"	"	Travancore ..	Logs .	Re. 0-11-0 per c.ft.
Benteak ..	*Lagerstrœmia lanceolata*	Cochin ..	Logs ..	Re. 0-7-3 to 1-0-4 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 0-14-0 to 1-2-6 per c.ft.
"	"	Travancore ..	Logs ..	Rs. 1-12-8 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Barwani ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 1-1-10 per c.ft.
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Holkar ..	Beams 14′×18″	
" ..	" ..	Hyderabad ..	Logs ..	Re. 0-6-0 to 1-8-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 1-0-6 to 2-0-6 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Sawn material	Rs. 1-7-5 per c.ft.
Deodar ..	*Cedrus deodara* ..	Patiala ..	Sleepers 10′×10″×5″	Rs. 7-4-0 each.
Dhupa ..	*Vateria indica* ..	Cochin ..	Logs ..	Re. 0-12-11 per c.ft.
Gamari ..	*Gmelina arborea* ..	Tripura ..	Logs ..	Re. 1-0-0 to 1-8-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Cochin ..	Logs ..	Re. 0-14-9 per c.ft.
" ..	" ..	Tripura ..	Logs ..	Re. 0-8-0 to 1-1-0 per c.ft.
Haldu ..	*Adina cordifolia* ..	Bansda ..	Logs ..	
" ..	" ..	Banswara ..	Logs ..	Rs. 1-4-0 to 10-0-0 per log.
" ..	" ..	Barwani ..	Logs ..	Re. 0-6-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Re. 1-0-0 to 1-14-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Mysore ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	
Hopea ..	*Hopea parviflora* ..	Cochin ..	Logs ..	Rs. 1-8-7 to 1-13-6 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-9-10 per c.ft.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bansda ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 0-12-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Re. 0-13-10 to 2-6-6 per c.ft.
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Kishengarh	Logs ..	
" ..	" ..	Mysore ..	Logs ..	Rs. 1-4-0 to 2-5-6 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	Re. 0-14-11 to 2-1-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul ..	*Xylia xylocarpa* ..	Cochin ..	Logs	Re. 0-8-6 to 1-8-7 per c.ft.
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-3-6 per c.ft.
Kindal ..	*Terminalia paniculata* ..	Cochin ..	Logs ..	Re. 0-6-0 to 1-3-8 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-2-8 per c.ft.
Laurel ..	*Terminalia tomentosa* ..	Bansda ..	Logs & squares	
,, ..	,, ..	Barwani ..	Logs ..	Re. 0-6-0 per c.ft.
,, ..	,, ..	Bhopal ..	Logs ..	Re. 0-14-0 to 1-8-0 per c.ft.
,, ..	,, ..	Cochin ..	Logs ..	Re. 0-8-6 to 1-6-2 per c.ft.
,, ..	,, ..	Holkar ..	Sawn material	Rs. 1-14-0 per c.ft.
,, ..	,, ..	Hyderabad ..	Logs ..	Rs. 0-6-0 to 1-8-0 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Cochin ..		
,, ..	,, ..	Tripura ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
Sal ..	*Shorea robusta* ..	Cooch Behar	Logs & scantlings	
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Tripura .	Logs ..	Re. 1-0-0 to 1-8-0 per c.ft.
Sandan ..	*Ougeinia dalbergioides* ..	Bansda ..	Logs ..	
,, ..	,, ..	Patna ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Banswara ..		
,, ..	,, ..	Cochin ..	Logs ..	Re. 0-8-0 per c.ft.
,, ..	,, ..	Cooch Behar	Logs & scantlings	
,,	,, ..	Rampur ..	Planks 6′ × 1′ × 1¼″ ..	
,, ..	,, ..	Travancore ..	Logs ..	Re. 0-11-0 per c.ft.
,, ..	,, ..	Tripura ..	Logs ..	Re. 0-4-0 to 0-6-0 per c.ft.
Sissoo ..	*Dalbergia sissoo* ..	Banswara ..	..	
,, ..	,, ..	Cooch Behar	Logs & scantlings	
,, ..	,, ..	Hyderabad ..	Logs ..	
,, ..	,, ..	Rampur ..	Planks 6′ × 1′ × 1¼″ ..	
Teak ..	*Tectona grandis* ..	Bansda ..	Logs ..	
,, ..	,, ..	Banswara ..	Logs ..	Rs. 1-2-0 to 4-0-0 per log.
,, ..	,, ..	Barwani ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft.
,, ..	,, ..	Bhopal ..	Logs ..	Rs. 1-8-0 to 2-8-0 per c.ft.
,, .	,, ..	Cochin ..	Logs ..	Rs. 1-2-5 to 3-7-5 per c.ft.
,, .	,, ..	Holkar ..	Sawn material	Re. 0-15-0 to 1-4-0 per c.ft.
,, .	,, ..	Mysore ..	Logs ..	Rs. 1-8-6 to 3-14-6 per c.ft.
,, ..	,, ..	Travancore ..	Logs ..	Re. 0-14-11 to 2-4-6 per c.ft.

have a Latin description followed by an adequate English translation (except in the case of *G. parkeri* V.N. p. 52). References to the literature are full, and any nomenclatural difficulties are resolved by a discussion after the description of the species.

We congratulate Mr. Narayanaswami on the production of this work which was completed as long as four years ago, and on which he has expended so much care and knowledge.

N. L. B.

EXTRACTS

FOREST RESEARCH AND WAR PROBLEMS

WORK AT THE DEHRA DUN INSTITUTE

BY S. H. HOWARD, I.F.S.,

Inspector-General of Forests to the Government of India.

The war work being done at the Forest Research Institute, Dehra Dun, has already been described in *The Statesman* of 7th September, 1941.

There is no need to repeat that general survey, and an account of certain particular problems and how they are tackled may be of more interest. For obvious reasons some of the most important work cannot at present be described in such an article as this, but there is plenty which can be told to illustrate the type of work done.

The Institute is composed of six branches, each with its own technical experts and assistants working under the direction of the head of the branch, and several of whom are in charge of definite self-contained sections. All these branches, the Botanical, Silvicultural, Timber Development, Entomological, Chemical and Utilization, are engaged in some form of war work direct or indirect. Naturally, by their very nature, the long term planning branches, like Botany and Silviculture, are not so directly concerned as the branches connected with the actual use of materials like the Chemical and Utilization branches.

Bamboo Tent Poles

But all branches contribute. There is a demand at present for millions of tent poles. They must reach their destination sound, yet various forms of damage and collapse have been experienced and

the rejections in some ordnance depots have been extremely high. This may be due to the supply of immature bamboos or the wrong species of bamboo, or from insect attack, rot or other destructive agencies.

An investigation was therefore planned for the whole problem. Bamboos are ordinarily identified by their botanical characteristics such as the leaves, sheaths and flowers. By the time a bamboo tent pole reaches an Army depot, however, it is in a finished condition and often complete with metal fittings, turks, head and so on. The Botanical branch, helped by the Silvicultural branch, has therefore recently drawn up a simple key to identify six species of bamboos in their finished state as tent poles. At the same time the Entomological branch is tackling the borer problem. The Entomologist discovered that the beetles, who are searching for starch (their chief food material), attack mostly the inner zone of the hollow bamboo, and as the outer covering of the bamboo is extremely hard and impervious, the Utilization branch had to devise a method of forcing preservative into these inner zones of wood quicker and less expensively than the usual method of soaking in preservative, which does not always work with bamboos.

Like so many successful experiments, the solution of the problem may be ridiculously simple. Experiments now going on indicate that if freshly cut bamboos are stood vertically in pots of preservative solution immediately they are cut and before the leaves have withered, the preservative is drawn up through the stem of the bamboo in sufficient quantities to preserve it from attack to a height of at least 18 ft. Try it yourself by standing the stalk of a freshly cut white flower in red ink and see how quickly the flower will begin to colour itself.

Fifteen Lakhs of Boots

It is just as true to-day that an army, which is supposed to march on its stomach, still needs boots, boots and then more boots. Boots have to be supplied not only to all the armies of India, in the Middle East and elsewhere, but also for the civilian demand in this country of four hundred million inhabitants. The army demand alone at the moment is about 15 lakhs a year. The raw materials

for this immense quantity, mostly leather, are available, and the factories can turn out the boots, but to make a boot you need a last. If you will think of the shape of a boot last, you will see that it must be cut from a block of wood about 12″ long and at least 4″ × 4″. To season such a block even in a kiln takes several weeks and with the sudden enormous demand for boot lasts there is not sufficient seasoned timber in the country to supply them. The Controller-General of Inspection, Ordnance Department, New Delhi, set us this pretty problem. The solution suggested was to make what are known as laminated blocks, that is to say, thin seasoned boards stuck together with a suitable cement so as to produce the same sized block 12″ × 4″ × 4″ and from that to cut the boot last. The advantages are obvious because a half-inch plank can be seasoned easily in a kiln in ten days or so, instead of several weeks required for the thicker four-inch wood, and at this speed the problem of the boot last can be solved.

The solution is not actually quite so simple as it sounds because it requires a rather special glue to hold the half-inch pieces together so that the laminated wood block is as strong as a solid piece of wood and this meant more research on the glue problem. It appears to have been solved in the Wood Preservation section which has evolved a formula for a case in glue of sufficient strength to do the work. Samples of laminated wood lasts have been made and were recently sent for final trials.

Synthetic Resin Glues

Glues for plywood and laminated wood are a very necessary material for several army supplies. Plywood, for instance, is being used for aircraft, naval construction, and bridge pontoons, and for such uses a very strong and completely waterproof bonding material is essential. If the glue adhesion of a plywood is 200 lbs. per square inch, it is usually considered sufficient, but the synthetic resins evolved at the Institute have given plywood adhesive strengths 500 lbs. per square inch and over 300 lbs. per square inch after the plywood had been in boiling water for eight hours.

Aircraft Timber

Research on aircraft timber has been going on for months. The very long spars needed for aircraft during the last war ruled out its

supply from the then known Indian timbers. But an investigation recently conducted showed that 75 per cent. of the timber used in modern aircraft (aircraft in its widest sense) is made up of quite short 10 ft. lengths. After a good deal of research into the suitable rate of growth to produce timber of the requisite strength, it was found that by careful selection Indian spruce and fir can supply the timber and that it is actually stronger than Sitka spruce, the only wood normally used for this work. In addition certain other species almost unknown and certainly untested at the time of the last war have since been found and appear to answer requirements. They are now being tried.

Treating Green Sleepers

A few months ago it was not known how to treat with creosote a green sleeper straight from the forest. This problem has been solved. As several lakhs of sleepers were required immediately for overseas and the quantity of naturally durable woods was probably insufficient to supply the demand, the comparatively quick solution of the problem was important. Largely as a result of this work, the sleeper creosoting plant at Naharkhatya in Assam has been re-opened and will soon now be treating green sleepers straight from the forest for our armies overseas.

Many New Problems

But there are many other problems for which there is no space to describe. The Medical Department needed pill and powder boxes. A cheap box was evolved from hollow bamboos and sent out for trial to the various commands in India. They were approved by the Medical Department, and arrangements have already been made for their manufacture. Plywood has been tested and samples manufactured for making dummy tanks for training.

A hot air seasoning chamber has been devised which is very much cheaper to instal than an ordinary seasoning kiln. If half wroughts for manufacturing shuttles, picker arms and tool helves for which there is an enormous demand, are partially air dried first, this cheap hot air chamber can finish the process quickly. In this way full seasoning can be reduced from about a year to two and half months. With the enormously increasing demand in India at present the

whole aspect of supply is altered by such a reduction in seasoning.

The supply of boot boxes for packing army boots is a further interesting development. These boxes were previously made of the well known *chir* pine but more easily available local substitutes were needed. At the suggestion of the Ordnance Department, this institute tested the relative strength of boxes made from *chir* and *semul*, a wood more readily available near the Cawnpore boot factories. The tests showed that the *chir* box was stronger than a *semul* box, but the *semul* had better nailing qualities and the timber testing section then improved the design of the box, increasing its strength fifteen times. With the improved design, *semul* boxes became a perfectly practicable proposition.

Aircraft propellers in sissoo, walnut and Andamans *padauk* have been made at the Institute for the Chief Inspector of Aircraft, Karachi, and have gone to him for test and report. So far the reports appear satisfactory. The Wood Technologist is continually identifying timber and plywood for aircraft inspectors, aircraft companies, inspectors of army motor vehicles armaments and ordnance factories, commercial firms and individuals. Over 1,200 such identifications were done for the army last year, besides training arms personnel in identifying woods.

The Chemical Branch of the Institute at the moment is trying to find a substitute for bees-wax which is largely used in polish to preserve and waterproof boots. Or, as another example, there is insufficient pith from the ordinary source of supply to make the large number of army topis now required. Various substitutes were recently suggested by the Institute which have partly the same characteristics as sola pith, such as bamboo pulp, banana leaves, *papier mâché* and certain grasses. A composition made of waste sola pith is also under experiment. If this is successful the present supplies of topi material will be increased by 20 per cent. At the same time, the supply of true sola pith from other sources is being increased by better cultivation and marketing.

The wireless aerials on army vehicles must necessarily be able to stand up to rough treatment. If the vehicle passes under a tree the mast bends down and is then forced to an upright position again by a strong spring. The recoil of this spring was found to be break-

ing many of the china insulators used in these wireless masts. The problem was sent here and within a few days a suitable wooden substitute was evolved which is now under trial on all the vehicles in one regiment. Reports received to date indicate that they are satisfactory.

The Institute is taking its share in the training of fitters, turners and electricians for ordnance factories under the Central Government training scheme and has recently been asked to double the number.

Results of the forest research are sometimes slow to appear. It takes many years to cover the groundwork of research to get into position to solve individual problems quickly. The Forest Research Institute has reached that position. Past expenditure on research has been repaid and it is the patient groundwork of the past which has enabled so many of these pressing problems to be solved quickly and satisfactorily.—*"India at War, Statesman Supplement,"* December 10, 1941.

PRIVATE ESTATES AND FORESTRY

By C. P. Ackers

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Some three million acres (or roughly 5 per cent.) of our land in Great Britain is woodland, which is classified into High Forest, Coppice, and Coppice with Standards. The High Forest may be exemplified by the majority of the woodlands in Scotland, and on our side of the Border by larch plantations and the more fully stocked beech woods of the Chilterns and the Cotswolds. Coppice in its saddest form can be seen in many of the areas in Southern England slaughtered in the last war; in its better form in the chestnut coppices of Sussex and the osier beds of Somerset. Coppice and Standards are the typical woodlands of Southern England; here the main standards are oak, ash and birch, with hazel undergrowth.

Historical Sketch

In considering the early history of forestry in this country, we need not go further back than the time of the Roman invasion, except possibly to note that certain trees such as the Norway spruce

and the Sequoias were growing here before the last Ice Age, got swept away and have been re-introduced by man. In the early history of the British race, a large portion of our land must have been under forest conditions, the chief natural trees of the country being alder, beech, birch, hazel, oak and scots pine. The Romans introduced such trees (now common) as the English elm, lime, poplar and sweet chestnut. The Norway spruce (the white deal of commerce and our common Christmas tree) was re-introduced about 1500, as was also the sycamore; common silver fir about 1,600; larch about 1720; and in the last century many trees that form the bulk of our younger plantations and the largest fir trees of our arboretums: those we know as Douglas, Sitka, *grandis*, lawson, Wellingtonia, Japanese larch and others less common.

Much forest land must have been cleared during the Roman occupation for military purposes and for cultivation; house-building, fuel and charcoal for iron-smelting were then the chief uses for timber and coppice. Later, in early Saxon times, the woods became used also for pasturage for swine, and the main areas were scheduled off by the more powerful lords for the "Higher Chase," the smaller game being allowed to the commoners. The very severe forest laws governing the royal forests (*silva regis*) were eased by Magna Carta and the new Forest Charter of 1225. The forests became more and more exploited as cultivation increased and enclosures were made on a large scale. till about 1500 we first begin to hear of serious timber shortage. More and more timber was wanted for shipbuilding and iron-smelting. General shortage and the poor yield of the woodlands were emphasized very strongly in the Statute of Woods, 1543, "Right well knowing the great decay of timber and woods universally within this his realm." Again, in the reign of Charles II, it was the alarm of the Commissioners of the Navy that caused John Evelyn (Reporter to the Royal Society) to read his famous paper on October 15, 1662.

So it went on until, soon after 1800, it began to be realized that teak from India might well replace the shortage, and in the middle of the nineteenth century the alarm died a natural death with the general advent of iron ships. Commerce greatly increased; free imports caused not only the value of big timber to drop but the

value of coppice to fall by more than fifty per cent. to an absolutely uneconomical price. Many landowners got poorer and poorer, robbing their woods more and more till they sold up, while the successful merchants began to buy and settle in the country and to rear pheasants on a grand scale. Thus the woods suffered, because forestry mattered less and less and the head-keeper became the boss of the woods. Under him rabbits increased, for he killed off more and more of their natural enemies. The wild cat, the polecat, the bigger birds of prey went first; then the stoat and weasel were decimated, and with agricultural depression weighing more and more heavily on the countryside the plague of rabbits was allowed to eat up wood and farm land alike. So we had the sad picture of almost all young undergrowth, almost every oak and ash and beech seedling being eaten off.

Hundreds of thousands of acres went from bad to worse till the Great War came and took away half of what was left. We were rich enough to stand it, but at the moment we are paying heavily for this, and future generations will do so too. Towards the end of the last war the country's utter dependence on home-grown pit timber supplies in time of trouble was keenly realized; especially was this so when the U-boat campaign was at its height. Then at last the politicians for once acted and formed the present Forestry Commission. Up till then, though the Government were frightened from time to time, they only took spasmodic action, and it was left to private enterprise to accomplish anything. An outstanding example of this was the Royal Society of Arts, which started in 1758 to stimulate sowing and planting by giving medals for successful work, and which continued its efforts well into the nineteenth century.

The development of forestry education in this country has also been far from enterprising. Sustained interest and education may be said to have started with the Highland and Agricultural Society in 1854 and the newly formed Scottish Arboricultural Society. Students were first taught in 1866; they were educated in France and Germany and were all destined for the Indian Forest Service. Later in 1885, they were trained at the Indian Engineering College at Cooper's Hill. Thus it is not surprising that in 1887 the report of a select Committee called attention to the "unskilled management

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and unsatisfactory" state of the Crown woodlands generally. From my experience I can say they were no better thirty-five years ago, about this time (1905), forestry education seriously started at Oxford under the late Sir William Schlich and the Board of Agriculture gave grants for lectures to be given at Bangor and at Armstrong College, Newcastle-on-Tyne.

At the present day, there are good, well-farmed woodlands on both rich alluvial and poor hill-land in this country, but there are very many more that are either far from perfect or lamentably bad. Not only do the woodlands of Great Britain cover a smaller percentage of the land than those of any other Continental country, but they are farmed far worse. In France, Germany, Switzerland and many other countries a true forest sense has been developed, in some cases for a century and more; but with our ample resources of coal, wood fuel is wasted to an extent unbelievable in other Continental countries, and with our extensive seaboard and mercantile marine we can easily import our timber needs. We love, admire and are very rightly proud of our gardens and arboretums—the finest in any country in the world and containing magnificent trees—but our semi-derelict woodlands are generally regarded as the sportsman's preserve, or merely as places of affection and æsthetic value where trees must not be harvested when ripe, but left to die a natural death. Seldom are they regarded as a sacred trust where timber for the present and future generations must be produced.

Achievements of Private and Government Enterprise

Now, having painted a sad picture of neglect for many centuries, I want to lay stress on the good things that have been done by private enterprise and by politicians, though they have not gone far enough.

Private enterprise has been responsible for much acorn sowing and later planting. First extensive plantations of larch and larch mixed with hardwoods were made from about 1750 onwards. Great Britain sent out collectors and brought home tree seeds unknown to civilized man, on a bigger scale than any other nation; consequently, we have established as good specimen trees and sample plantations as any country. Many of these trees have promised so well that they have been extensively tried out in private and State

lands. Many of the large landowners have established quite extensive woodlands, and for several generations their descendants have kept them well cropped and well regenerated. The detailed management of this work has been done by working foresters, who are as a rule Scotsmen, and self-educated as far as forestry is concerned. They have done their work well and set a fine example. Other smaller owners have done equally well and have often from sentimental reasons left the crops to grow on to full maturity. These, however, are the exception rather than the rule, but they demonstrate what can be done.

Various Governments have also in the past fifty years passed Acts to encourage the growing of timber. Excessive rates, often up to £1 per acre, were at one time imposed on private woodlands, and as income tax is also based on the same rating, the burden borne was criminally excessive. The assessment value was, however, reduced to a basis of not more than 2s. 6d. per acre, plus the sporting value or, if the owner chose to keep full accounts, to the actual profit made. Concessions on death duties have also been made, the duty payable on growing timber being separated from the remainder of the estate and the incoming owner not having to pay till the timber is cut; this is a big concession not realized by the majority of owners. Recently also the Government have given cash subsidies to owners for planting, varying from £2 to £4 per acre, which certainly helps.

Advantages of Mixed Crops

But what is the good of all this when the big fundamental principles of good forestry and estate management are ignored by those in authority? God has given us our pleasant land, the actual soil; this is the one thing that stays with us from generation to generation and we hold it in sacred trust for future generations to make more fertile by wise cropping. This is important enough in farming, yet for many years there has been nothing to prevent a tenant farmer taking over land in good heart and skinning it of all its stored-up fertility; there has been nothing to prevent a man buying good land and letting it go to waste. If this is wrong with farm land that may in a few years be got back again into good heart, how much more serious is it with forest land where a single cropping

may take several generations? Conversely, once let forest land get sour and out of heart and it may take several generations to recover its fertility.

This is why it is so essential, wherever it may be done with any reasonable prospect of success, to grow mixed crops which include broadleaved trees. Mixtures are more difficult to manage than pure crops, and from ignorance, laziness or indifference it has become the tendency to plant pure, dense blocks of firs or pure larch. The final result with the latter is not too bad if the crop is left to maturity, for then bramble and other useful forms of ground vegetation begin to ameliorate the soil, under this light-demanding crop. The ideal to aim at, however, is a final crop of big timber consisting of a good proportion at least of oak, ash, sycamore or beech. One of the best conditions for regeneration comes from a final crop of pure oak, or a dense crop of oak and hazel standards and coppice; about the worst conditions are given by a dense final crop of pure spruce.

Timber crops should therefore be looked on from the two-fold point of view of, firstly, their value as thinnings and final crop; secondly, their value in improving the general health of, and preventing the spread of disease in, their neighbours, and in improving soil condition both for themselves and the ensuing crop. Take the case of groups of oak planted at intervals throughout a spruce or larch crop: on good ground at moderate levels, the best oak should come to full maturity after the last spruce or most of the larch have been marketed. They will form the final crop; their function has been to add to the health and growth of the conifers by their leaf mould, to form the main final crop and to keep the soil conditions in good heart for the succeeding crop. On higher land their function will have been similar, except that the general rotation will be a shorter one and, unless the soil of this high land is specially suited to oak (as it sometimes is), they will only form a proportion of the final crop; then they will be marketed as second-quality timber. On higher land still sycamore and beech can well be used to fulfil the same purposes: at well over one thousand feet above sea level fine final crops of beech, with some ash and sycamore, can be grown where soil conditions are reasonably favourable.

There are other advantages to be considered in these mixed crops. The risk of fire is less in them than it is in solid blocks of conifers, where the danger of wholesale devastation remains throughout the whole period of their rotation. The æsthetic side must also be considered: there is so often lack of beauty and little, if any, bird life in these conifers forests. Both these facts are of real importance when we want to train up our general public into sympathy with good forestry and all it stands for: . too often the forester is looked on as a vandal, hacking down things of beauty and stature and replacing them by dull serried ranks of gloom. It is true that in their final stages, there is grandeur and some beauty in pure coniferous woods, with fern, bilberry and raspberry canes growing under them, but they should be the exception rather than the rule. A further advantage of these mixed plantations is that, after their final felling, the ground, if fairly free from rabbits, should be full of young oak, ash and other hardwood seedlings; these will be in the ideal state to come away well with planted conifers, and they will in any case make good any losses in the groups of planted broadleaved trees. Planting should take place immediately after the felling (the same winter if possible); full advantage is then taken of the accumulated leaf mould by the newly planted crop and much cost of cleaning is saved. Contrast this with the final felling of a spruce or pine wood. In that case the ground is left covered with a thick layer of sour needles, and it must lie derelict for some five years, on account of the ravages of pine weevil, before it is re-planted. Even then but slow growth of the ensuing crop can be expected in its early stages, till the accumulated mass of needle is disintegrated; the purer the conifer crop the slower is this process.

There is yet another most important consideration. In the only book I have ever written I devoted a whole chapter to "Sport and Modern Forestry." I am as fond of my shooting as most, and there I tried to show that by handing over a few acres in every hundred to holding cover (and cash returns may be got even out of these) better sport and higher birds and just as big a head of pheasants may be reared in well run High Forest woodlands as in the derelict stunted woods that are so common. The latter are occa-

sionally too dense with hazel, but they are usually impenetrable with bramble. The standards being low and stunted, low-flying birds result, except on really hilly ground. Good cover may be got under final crops of larch and oak; the taller the timber the higher the birds on dead level ground: so, under good organization, the better the timber yields the better the sporting value.

I have stressed this point of mixed plantations, as this and the value of thinnings are probably the two most important points to be kept permanently in the fore-front in dealing with English estate woodlands. If the Government decide that it is essential to grow masses of dense fir for the country's needs, to the detriment of fertility, beauty and safety, that is for them to decide: they deal with more hilly and exposed land than do the majority of private owners, but I am absolutely convinced that private estate forestry should bank on mixed woods. Where soil is suitable, ash, oak and larch should be the mainstay: on the Cotswolds and Chilterns where beech is the tree, beech and larch should be grown together, with some oak, ash and sycamore where the soil is deep enough. Crops of these, in proper rotation. with small areas of hazel or chestnut coppice, will give the ideal basis for a steady, good income and good sport. And be this here noted: well run woodlands, year in year out, pay an owner better than well run farm lands.

Economic Handicaps

Much remains to be done for our woodlands; a long-term policy is essential and the need is great, for our woods are inexorably mixed up with our farm economy. Why should tens of thousands of farm gates and hundreds of miles of fencing be made every year out of knotty foreign deals. Why cannot rural woodland industries for making hoops, bar hurdles, wattle hurdles, gates, wickets and wheelwright timber, rent oak, pegs, rungs, spokes and so on flourish? Why for years and years should train-loads of empty trucks have been sent south from Inverness, passing empty through Scots pine forests, unthinned because of excessive railways rates, continuing empty through to the Lanark coal-fields, one of the dumping grounds of foreign pit-props? Is it right that special concessions be given on our railways to foreign timber? In most civilized countries, home-grown

timber, not foreign, is given the preference (I am, of course, talking of times of peace).

Take a normal pit timber wood, or even a plantation of mature fir, and consider if the following typical example is just. The consumer can afford to give 1s. 6d. delivered per unit for the raw material. Of this the man who spends a few minutes cutting it down gets 1½d.; the extraction to a hard road costs 2½d. for an hour or two's work; cartage to station costs 3d. for half a day's work; the railway take a day or so to deliver and charge 8d. a unit, and the grower gets what is left, the princely sum of 3d. (less agent's commission), for waiting for thirty to seventy years; this for interest plus return of capital. Now if he is lucky or wise and has his crop really accessible he may cut his extraction costs by 1½d. and increase his net return by fifty per cent. On the other hand, if the railway charges more for a longer haul, or if the situation is really bad, the owner may get nothing, or his thinnings may be actually worth a minus quantity. Is this just?

The result of this state of affairs, coupled with lack of organization, has been that after much money has been spent in England and Scotland on establishing fine young plantations, practically everywhere these stand utterly underthinned and full of dead and suppressed trees. This means waste of material to the country as a whole, lack of income to the owner (and consequently less capital and less inclination to plant more), and crops of attenuated poles instead of valuable saw-mill timber. Regretfully, I paint a sad picture of England's plantations as well as of her older coppice and standards woods, and all because no Government has yet got down to making good forestry reasonably possible, secure and profitable.

The Future

The late Professor Troup, in his recent and excellent little book *Forestry and State Control,* says: "No country can afford to neglect the duty of safeguarding its future timber supplies;" and again: "There are reasons why the encouragement of private forestry on proper lines is desirable. It produces a community of interest between the individual and the State and inculcates a forest-sense and an appreciation of the value of forest property, that would be

impossible in the case of a purely State enterprise." What, then, do we want to bring this about?

We want more Members of Parliament who can talk with intelligence and experience on forestry matters, and criticise with authority the work of the Government Forest Service.

We want a section of some Government Department sympathetic to private estate forestry. This should be under the Ministry of Agriculture who, as the Board of Agriculture and Fisheries, made our first grants for lectureships in forestry. Although individual Government Forestry Officers may extend a sympathetic hearing to the needs of private forestry, the fact remains that they are the chief competitors. They have their own Service to consider first. It is only natural that a young and rapidly growing Government Service should have but little time to spend on private woodland which, as a whole, has had but yet little chance of improved management in the first quarter-century of the Commission's existence. They have as the Timber Authority, so controlled prices, for the present crisis, that a big margin is left to the exploiter of timber (not the grower) and they themselves are the biggest buyers and have this large margin to work on. Any surplus should rather have gone either to the neglected grower or to cheapen the timber price to the consumer. The powers-that-be in the Central Landowners' Association did not help owners very well in this case.

We want a strong private body of consultant foresters, not Government officials, not auctioneers or land agents, but genuine whole-time foresters. Here the natural jealousy of the great majority of estate agents and auctioneers must be overcome. It is they who have handled so many private woods and woodland sales in the past and are largely responsible for their present lamentable state.

We want efficiency and still more efficiency, real and practical. For example, I should like to see travelling commercial units which could move on to an estate for three weeks or three months. They should have a staff competent to mark and sell timber; select, mark and sell thinnings; get out a small working plan; supply trees and establish and maintain young plantations. They should bring an efficient plant to convert timber for estate use, creosote what is necessary and make on the spot a supply of farm gates. Finally, they

should leave several years' supply of planks, boards, gates, rails, etc., properly prepared, treated and stacked. The inefficiency of the average estate saw-mill is stupendous.

We want co-operation of estates, as in Denmark and Finland, with a competent private forester employed by each group. The Home-Grown Timber Marketing Association may do some good, but co-operation is infinitely more important in production than in sale.

We want legislation to curb or kill those vultures, the estate speculators, who rip every saleable stick from the woodlands and farms and leave behind a waste of lop and top. We want a law here, as in Denmark, strictly limiting timber felling, after a sale of land, for a ten-year period, and thereafter ensuring that regeneration follows.

We want, as in Norway and Sweden, compulsory re-afforestation by the Government, after felling, at the expense of the owner if the latter neglects his duty.

We want compulsory working on the system of sustained yield, as in Finland—a country whose late Premier was a forester of international reputation—and we want, among other things, some control over thinnings so as to maintain a correct density.

Further, I should like to see several centres where working foresters could be properly trained for duty on private estates; this should be on the lines of the Government centre in the Forest of Dean. They should receive grants from the Ministry of Agriculture, a body which has always shown itself generous, helpful and sympathetic to the great body of private farm enterprise it serves.

I should like to see real national support for the Royal English and Scottish Forestry Societies—those truly cosmopolitan bodies which have struggled long, though rather feebly, for the cause of forestry: it would be a thousand pities if they were swamped by any Government Department.

I should like to see big corporations and colleges making investments in well-run woodlands—too often do we find hopeless cropping under such management.

I should like to see a well-illustrated and well-printed popular periodical on forestry, such as Canada has.

I should like to see more attention paid, especially by Government foresters, to quality production and more interest taken in high-pruning. I have never believed in a serious world shortage of timber, but for many years have been convinced that we shall have a surplus of third-quality, an insufficiency of second-quality and a complete famine of really first-class timber; this latter will command its own price.

I should like to see a better market for firewood and charcoal, as well as an assured market for turnery timber.

I should like to see our biggest land-plague, the rabbit, permanently curbed. To accomplish this our law-givers should forget the rabbit itself and concentrate on penalising open rabbit holes.

Finally, I should like to see some retired wealthy business men take a fatherly interest in forestry, as some have in British Agriculture, with a view to helping on these and other ideas. Ever since God gave us our woodlands we have mismanaged them: is it too much to hope that, after we emerge victorious from the present titanic struggle, we may see the foundations laid for a long-term forest policy whereby State, communal and private forests, working in harmony and co-operation would grow crops worth while?—*Quarterly Journal of Forestry*, Vol. XXXV, No. 3, dated July, 1941.

NORWAY AND ITS FORESTS

By Finn Frost.

A Norway without forests is unthinkable. From the beginning of time our forests have played the most important part in the nation's struggle for life, prosperity and happiness. About ten thousand years ago, when the big glacier was pushed from the coasts into the higher mountains, the Scots pine, together with a tough army consisting of birch, mountain ash, grey alder, juniper, aspen and many others came like a blessed invasion from the south. In spite of the huge expanse of sea, even Scotland made a tribute to this creation of land and life. You gave us your beauty queen, the heather. Though it has a doubtful reputation in modern forestry for building up raw humus, it has so many deeds to its credit that its importance in Nature cannot be exaggerated. In spite of hard

fights against storms and winds, it crept up the valleys, up the steep hillsides and over the mountains, giving shelter to more sensitive seedlings and plants, giving food to the grouse and other game. And thanks to this Royal Scottish gift the Vikings got honey to make their much beloved strong *Mjod,* which they drank before, as well as during and after battle. Later on when the climate became warmer, the more warmth-loving species, like oak, lime, elm and a little beech, took possession of the fertile slopes in the south and west coast fjords.

Then last, but not least, came the Norway spruce, our most important tree. Though the spruce is only about 5,000 years old in the country, it is blessed with such a fighting spirit that it has chased away the pine and the birch, even from places where the soil is not suitable for it. The creation of the country was thus finished from Nature's hand, and was ready to welcome the first man. Men came from the south in boats, some fleeing from justice, some just seeking adventure. They all found good living conditions in this new country. There was plenty of fish on the banks and in the fjords; the rivers and lakes were full of salmon and trout, and, above all, there were the woods to give them shelter, to give them timber for their houses and boats, to give them heat, to fight the cold, and to give them meat and furs. And through all the known centuries of history it is the forests in co-operation with the sea that have been the backbone of the Nation's strength, welfare and standard of life.

In recent years iron and concrete have to a large extent replaced timber for house and ship building, but luckily men of science and industry found new fields for the use of wood, such as paper, silk, and wallboard. And now during the war it will assume an added importance to the country in replacing petrol, which will be unobtainable. During recent years gas generators for wood and charcoal have been invented and found useful for heavy lorries, light cars and motorboats. The country has natural conditions for developing a sound modern industry based on wood. Thousands of rivers carry the timber cheaply to the factories at the coast. Waterfalls give any amount of electric power. Good harbours are open all the year for our merchant fleet to carry the products all over the world. As well as shipping, fishing and whaling, the export of wood products has

been of the highest importance to the balance of trade. It has been as high as 40 per cent. of the total exports in one year.

In addition, the woods have an enormous importance for indigenous purposes. Wood is still the most used material for construction work, house building, etc., specially outside the bigger cities. And wood is still the main heating source, as we have no coal mines except on the island of Svalbard in the Arctic Ocean. In relation to the final value of the product, the woods owner may earn from ten to forty per cent. The rest goes as wages in the woods, along the rivers and in the factories. Having such a great influence on the welfare of the whole country, it is quite natural that the people through legislation have tried to preserve the forests and to increase their yield. But it has been a very difficult task. For years the owners fought against any restrictions of their rights to the free disposal of their woods. Many owners thought only of the present money they could make, ignoring the future yield. The result was that the quality and increment of the woods decreased dangerously. Thanks mainly to the indefatigable work of the present Director of Forestry, K. Sorhuus, we got a new law on forestry in 1932, which is rather revolutionary at many points. The forests are now all under professional control, yet a man can work his woods as he likes as long as he does so in a rational way. But if he cuts wildly, without thought of the future, his free disposal will temporarily be suspended and a state forester will issue instructions on how the forest must be worked. The result is that most owners make it a point of honour to follow the rules of rational silviculture and are keen on collecting knowledge on forestry subjects. Another important point in the new law is a tax of 2 per cent. which the owner pays on all the timber he sells. The money will in due course be used in his own woods for planting or other silvicultural work. In spite of dark forebodings, this law has become very popular in almost all the country.—*The Scottish Forestry Journal,* Vol. 55. Part 1 dated March, 1941.

USE LESS WOOD MORE INTELLIGENTLY

"Use less timber and use it more intelligently," is the wise counsel offered by a commentator in a recent issue of a contemporary journal.

There is actually more in these words than meets the eye. Though they apply primarily to our present conditions of strictly controlled consumption, they have an equally important bearing upon the whole question of timber utilization. At the moment it is necessary to see that the maximum value is obtained from every cubic foot of wood drawn from our national stocks so that no shipping space shall be wasted. This means not only using the least possible material for any particular job but also taking care that the economy does not result in either structural weakness or improper application of the wood used. Either of these may produce deterioration and give a false impression as to timber's serviceability. To-day timber merchants are much preoccupied with the very necessary business of storing, converting, and distributing the stocks allotted to them. They are having to do this handicapped by such things as the fact that their goods have been dispersed to rural storage sites, and that their staffs, though reduced in number, have to cope with the additional clerical work attached to the control system.

It is not surprising, therefore, that they have little time left over in which to reflect upon things in a detached manner and to concern themselves with the "long view" of the timber trade's position. Happily, there are still some of the Olympian Guard among them who are able to appreciate the picture in its true perspective. It was these men who had the foresight in peace-time to found the Timber Development Association which has done so much to assist the intelligent use of wood. They realized that it was beyond the scope of the commercial man to produce the data which consumers need—data which helps the customer to make the best use of the timber purchased. In this direction the T.D.A. has been of inestimable help and the research work carried out at Princes Risborough has provided much of the data which the engineer and architect requires. *Wood* has also, we believe, played a useful role in making available in an attractive form a great deal of authoritative information on various aspects of timber production and consumption. We

feel bound to agree with the remarks made by a timber importer who deplored the ignorance of himself and his fellow-merchants in these words: "Here I am," he said, "I've been in the trade for forty years and yet I cannot tell you the minimum scantling which at any particular centering will bear a given weight. That's where the steel people have got us whacked!"

His particular complaint is being dealt with by the production of a book of tables which is now in the hands of the T.D.A. When these are published they will be a help to many people who handle timber. Those who are concerned with the marketing will find that by using such tables as these they can be of much more assistance to their customers. They may be able to show for instance that a $3\frac{1}{2}$ in. by 2 in. will serve a purpose for which the buyer intended to use a 4 in. by 2 in., and thus save him $12\frac{1}{2}$ per cent. There are still a few short-sighted merchants who think that this is contrary to their interests fearing that it will reduce the volume of their sales. They forget that the ultimate factor which determines the quantity of timber used is the multiplicity of the jobs on which it is specified and the number of functions which it fulfils upon each individual contract. If, by efficient economy in application, less timber can be made to do more work, the resultant cheapness in comparison with other materials will tend to increase the demand for it. In any case, so far as the immediate—and even the post-war—future is concerned, the dictates of shipping space and currency restriction will make it necessary for us all to give close attention to timber economy.

Great care must be taken to see that these economies are based upon sound foundations and that nothing is left to the vagaries of chance. We have in mind the type of wooden buildings which one has seen too often in the past with a sagging ridge and bulging roof. If some of the timber which had been wasted in a superabundance of stoothing, had been utilized in the fabrication of the roof, the structure would still have been in sound condition. We have also seen buildings which, though of unnecessarily heavy construction, have not stood the test of time simply because they were not properly ventilated beneath. Dampness has been followed by decay.

Fortunately, we do seem to have profited by experience and our methods of construction have improved. There is, however, still need for us to give more attention to the matter of using less wood but using it more intelligently.

— *Wood*, Vol. 6, No. 9, dated September, 1941.

INDIAN FORESTER

APRIL, 1942

PLANTATIONS IN THE TWANTE-KONDAN RESERVE, INSEIN DIVISION, BURMA

BY F. ALLSOP

It is believed that the Twante-Kondan Reserve of Insein Division is the only place in Burma where guava is used to help in the formation of cheap and successful *taungya* plantations. The reserve now covers about 6,600 acres in five detached blocks, one block and part of another having been disforested very recently; the average area is 1,320 acres, the blocks varying in size from 3,000 to 900 acres. It is of purely local interest, for supply of house-posts, timber for agricultural implements and firewood.

The condition of the reserve when reservation took place in 1900 cannot now be ascertained, but large numbers of villages were given rights to unspecified amounts of timber for domestic and agricultural purposes, and the depredations of right-holders and thieves up to the time when the first silvicultural measures were attempted, did nothing to improve what was probably indifferent, woodland to start with. When the forest was examined prior to regeneration operations all the blocks now surviving were found to be much the same and to consist chiefly of poor forest of the lower mixed deciduous type, with *Eugenia* spp. (*thabye*), *Careya arborea* (*bambwe*), *Carallia integerrima* (*maniawga*), *Diospyros ehretioides* (*aukchinsa*), *Lannea grandis* (*nabe*), *Fagraea fragrans* (*ananbo*) and *Grewia microcos* (*myatya*) as the principal species. There was a little evergreen forest along the streams. The whole showed every sign of neglect and abuse: growth of all species was miserably poor, there were considerable blanks and thinly stocked areas and climbers and *ficus* flourished everywhere.

Although the reserve held out no promise of first-class crops of valuable timber the general character of the soil, which is a light loam or sandy, and of the existing crop, was considered to indicate

a good possibility of raising durable house-posts and good firewood by planting. The position as regards climbers, desirable seed-bearers, blanks, etc., was completely unfavourable to the employment of natural regeneration.

There are vague records of an attempt about 1915—17 to regenerate by coppice and to enrich the poor natural regrowth by planting patches or widely spaced lines of *Tectona grandis* (teak), *Hopea odorata* (*thingan*), *Careya arborea* (*bambwe*) and other species. For various reasons these experiments came to nothing and it is not now possible to trace even their precise location, but they are of interest as constituting the first efforts at improvement.

In 1922 it was decided to apply to the reserve the *taungya* plantation technique then so fashionable. The initial steps were taken with great boldness, about 150 acres a year being attempted in the first few years. Luckily this courage was rewarded with a good measure of success. Trials were first given chiefly to local species, such as *Eugenia* spp. (*thabye*), *Careya arborea* (*bambwe*), *Heterophragma adenophyllum* (*petthan*) and *Lannea grandis* (*nabe*), but small plots of *Mesua ferrea* (*gangaw*), *Hopea odorata* (*thingan*), *Acacia catechu* (cutch), *Artocarpus integrifolia* (*peinne*) and *Xylia dolabriformis* (*pyinkado*) were also put down. *Thabye* covered by far the biggest area to start with.

The plantations were made by what is now known as the vegetable-*taungya* method, the area being cut and burnt as in an ordinary hill *taungya*, then planted with *monla* (a kind of radish), and brinjal or sweet-potato on mounds between the trees. No rice was sown. Within the first year or two, guava, which is grown in considerable quantities in the Twante Sub-division for the Rangoon market, was also introduced as *taungya* crop. It persists for six or seven years in the plantations, is usually in bearing during its fourth to sixth years, and does not fruit if unduly shaded, so needs special arrangements for successful use in *taungya*. It was found that the best method of culture was to plant it at alternate stakes with the tree species.

In the early years in addition to the species listed above, teak, *Albizzia procera* (*sit*), *Albizzia lebbek* (*kokko*), *Albizzia odoratissima* (*thitmagyi*), *Homalium tomentosum* (*myaukchaw*), *Lagerstroemia flos-reginae* (*pyinma*), *Eriolaena candollei* (*dwani*), *Gmelina*

arborea (*yemane*), *Artocarpus chaplasha* (*taungpein*), *Dipterocarpus* spp. (*kanyin* and *in*) and *Carallia integerrima* (*maniawga*) were all tried, at various spacings with and without guavas. They are recorded as having been planted $7' \times 7'$, $\times 7\frac{1}{2}' \times 7\frac{1}{2}'$, $6' \times 6'$, $9' \times 9'$ as well as in "quincunx" formations at some of these spacings. When guava was grown the *ya*-cutters did weeding free as long as their fruit trees were in profit, but when it was omitted Government assumed responsibility for tending at the end of the first or second year. Plantations without guava were, therefore, relatively expensive, particularly as in many cases rewards were also paid for live plants.

The experiments showed that successful plantations of *thabye*, *pyinkado*, *peinne*, *taungpein* and *myaukchaw* could be formed and brought up without great difficulty. Teak, *kanyin*, *in* and *bambwe* could also be grown, with less satisfactory results. The other species have been partial or complete failures, some, such as *kokko* and *thitmagyi*, dying off at 5 or 6 years old, after a promising start.

Among the successful species *pyinkado* has the advantage of yielding both house-posts and firewood of good quality and has rightly been selected for the bulk of the planting of recent years. Its habit of growth makes *thabye* incapable of yielding anything but firewood and the inferior timber of *peinne* and *taungbein* rules them out so long as *pyinkado* can be successfully grown. *Myaukchaw* is worth consideration to break up too large blocks of *pyinkado*.

Modern practice is to plant *pyinkado* only, at a $7' \times 7'$ spacing, with guava at alternate stakes. In the first year the *ya*-cutters grow *monla* and brinjal on round mounds between the stakes, in the second (and sometimes the third) sweet-potato and a little *seinza-u* (a tuber-producing legume), usually on long mounds between the rows of trees. *Kalaw* (tapioca) has been tried in the second year but its luxuriance is harmful to *pyinkado* and guava alike, and it takes a full year to mature. The *ya*-cutters are supplied with *pyinkado* seed only. They weed and tend the tree crop under the general supervision of subordinates as long as the guavas bear enough fruit to make it worth while collecting, usually up to the sixth year, but fire-protection is done by the Forest Department. No rewards are paid. For patching of blanks in the second year,

peinne and *taungbein* have been found useful. They have also been put down in the original planting when *pyinkado* seed was short or crickets, which are at times a serious pest in Twante, have destroyed successive sowings of *pyinkado*. The total cost of a plantation at five years is Rs. 4.5 to Rs. 6 per acre.

The *pyinkado* crops eventually taken over are more widely spaced than is usual in Burma plantations, and the trees are relatively bushy, but the stand is within the capacity of the soil—a condition not obtaining in all plantations in Burma—and growth is generally satisfactory. Pruning has been tried to improve badly-shaped trees, but however carefully carried out it seems to have introduced a point of weakness in the trees subjected to the operation. There seems no great difficulty in eliminating ill-shaped trees during thinnings and pruning has been discontinued.

Attempts have been made to introduce improved types of guava but those tried hitherto have been later in coming into bearing than the local variety, shorter-lived and less prolific, though the fruit was larger.

The results achieved to date are about 2,400 acres of successful plantation of which some 1,800 acres are principally *pyinkado*. According to the prescriptions of the 1937—47 Working Plan the area to be planted annually is 208 acres in 4 cutting series: the average achievement of the last five years, owing to the restrictions imposed by Government on the acreage planted, is 134 acres a year. The full planting programme would cover all the suitable area by the end of the 30-year rotation prescribed.

Average height and girth figures for *pyinkado* in typical plantations are:

Block	*Year of plantation*	*Age*	*Average height*	*Average girth*
Kyundaw ...	1923	18	60′	2′ 5″
	1924	17	49′	2′ 7″
Kawhmu ...	1925	16	45′	2′ 0″
	1928	13	36′	1′ 3″
Peinnegon ...	1925	16	40′	1′ 10″
	1926	15	36′	1′ 8″

so there seems every prospect of a useful product at 30 years,

The next rotation will undoubtedly have a much improved soil to work with. Fire-protection has produced in the *pyinkado* plantations a ground covering as closely approaching humus as is ever seen in Burma. Thinnings began only 3 years ago and receipts from sales are still small, partly because the plantations start off widely spaced and have not yet produced many thinnings and partly because the small timber from the plantations has not yet established a market for itself in competition with similar produce from the Irrawaddy Delta. Receipts amount to Rs. 100—150 a year, but are likely to increase.

SIGNIFICANCE OF TEAK-SAL MIXTURE FROM THE STANDPOINT OF PLANT SUCCESSION

By A. B. Lal, B.SC.,

Range Officer, Kanker State, E.S.A.

It is well known to every forest officer that teak-sal mixture is regarded as a rare phenomenon in Indian forests. The phenomenon appears the more strange in view of the fact that the two species have got more or less conflicting silvicultural characteristics. Teak is a strong light demander and remains leafless for about five months in the year. It is predominantly a surface rooter and requires well-drained soil for its growth and development. Sal, on the other hand is a shade-bearer and is semi-evergreen. It is prominently a tap rooter, its lateral rootlets being very feebly developed. It requires comparatively more soil-moisture than teak and is not so fastidious as regards drainage.

The only mention of the occurrence of the mixture is to be found in Troup's "Silviculture of Indian trees" wherein he says: "Teak is not ordinarily found mixed with sal, but occasionally the two species occur mixed, for example, in Bilaspur district, where there is a small area of teak mixed with sal poles near Deosara in the west Lormi range. The requirements of the two species differ, teak seeking a good subsoil drainage with a fair amount of rainfall and sal seeking the more hygroscopic soil."

Mr. Harlow, in his working plan for sal ranges of Raipur division, while describing the vegetation on the bank of Mahanadi

river says: "Teak grows on alluvial soil; sal in these areas occurs as an individual tree and is not gregarious."

In Risgaon range of Raipur division, where I was posted for my practical training, I had observed teak-sal mixture growing in compartments 167 and 172 along the bank of Sondul river.

It is, therefore, clear that teak-sal mixture is not a *very* rare phenomenon, but it is also equally true that it is not a widespread phenomenon to be commonly met with. The object of this article is to afford a tentative explanation for the existence of this relatively rare mixture and to discuss its ecological status.

Mixture of teak and sal is confined to Saimura-Borgaon block of Kanker range along the bank of water courses. The mixture is prominently observed along the bank of Turi river where the soil is a drift one, being formed by the action of water.

Locality factors of the area

Mean annual temperature: about 80°F.

Mean annual range of temperature: about 35°F.

January mean temperature: about 53°F.

Maximum temperature: about 110°F.

Minimum temperature: about 48°F.

Mean annual rainfall : 60 inches.

Seasonal distribution of rainfall:

Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.
.32	.94	.47	1.1	1.4	10.4	17.9	12.5
Sep.	Oct.	Nov.	Dec.				
10.5	3.9	.73	.12				

Physiography

The area is more or less flat with a gentle slope towards the south-west. It is cut up by a network of rivers and the whole of the soil is a drift one. According to Glinka's system of soil classification all soils are, in the main, climatically conditioned, the geology playing almost no part in mature soils.

The climax soil for the above locality is a lateritic profile with red 'A' horizon and bleached 'B' horizon.

Biotic factors

The surrounding country is very sparsely populated and it may be safely assumed, for all practical purposes, that the forest is free from the effects of grazing, burning and other biotic activities.

The principal stages in primary succession along the bank of water courses are as follows:

The pure mineral soil is colonised by xerophylous species which are especially adapted for growing on pure sand. The different species, in the descending order of frequency, which constitute the first colonisers are:

Saccharum spp. *Tamarix dioica, Vitex negundo, Acacia catechu, Zizyphus oenoplia,* etc.

When the pioneer species stand on the pure mineral soil for a great length of time, the soil is changed into sandy loam due to the reaction of the first colonisers upon it. The area is then colonised by teak, its seeds being dispersed by the action of water. In due course, it dominates, drives out the pioneer species and reaches its best development. The height growth of teak in this area is about 80 feet.

The soil undergoes further transformation under the influence of climate and vegetation. Gradually the soil turns into pure loam and shows a tendency towards the formation of a lateritic profile. Teak remains deciduous for a great length of time adding very little of humus to the soil. Owing to high bacterial activity, the decomposition of humus takes place very rapidly. During the post-monsoon season the movement of water in the soil is predominantly upwards. The sesquioxides of iron and aluminium are, therefore, carried to the 'A' horizon and, owing to the absence of any humus, are precipitated as murram-like concretions which are highly inimical to teak regeneration.

Teak, being mainly a surface rooter and requiring well-drained soil for its growth, is very susceptible to adverse conditions in the 'A' horizon. In addition, the seedling regeneration of teak does not get light adequate for its growth and development. A large number of seedlings were dug up in the area and examined. All of them had impeded root development, and branchiness in the tap-root of the seedlings was invariably noticed. Climbers are rare in pure teak areas. The next stage in succession is the development of an understorey of *Cleistanthus collinus, Holarrhena antidysenterica, Bauhinia racemosa, Kydia calycina,* etc., followed, in due course, by the invasion of sal seeds which are dispersed through the agency of wind. The climbers begin making their appearance

with the development of understorey of miscellaneous species and become conspicuous with the establishment of sal. Important climbers are *Ichnocarpus frutescens, Dioscorea* spp. *Butea superba, Bauhinia vahlii* and *Smilax macrophylla*.

In its competition with teak, sal gradually gets the upper hand of teak due to its following silvicultural characteristics:

1. Shade-bearing nature.
2. It requires comparatively more soil moisture than teak, can grow well on pure loam and is not so sensitive to drainage.
3. It is a tap-rooted species, pushes its tap-root through the 'A' horizon relatively quicker and derives its moisture and nutrients mainly from the 'B' horizon.
4. Light winged seeds and gregarious nature of the species.
5. The ultimate height growth of sal is greater than that of teak, sal reaching a height of 90 feet and teak only 80 feet.

The result is that due to the cumulative effect of climatic and vegetative reaction on the site and to the hardy silvicultural characteristics of sal, teak gradually begins losing ground and, in due course, is driven out lock, stock and barrel leaving a climatic climax formation of sal.

Sal is the climatic climax in this range both on soil formed *'in situ'* as well as on mature drift soil. Sal is of dry type here and regenerates itself like a weed.

Last year during our peninsular India tour we saw a teak plantation in western Porahat division of Bihar which was made on soil formed *'in situ'*. After a certain number of years, following cleaning operations, the plantation was invaded by sal, and teak had to be cut. Although the intrusion of sal in this particular plantation may not have any direct bearing with the subject under discussion, nevertheless it suggests that where the climatic climax is sal, teak (whether natural or planted) stands the danger of being ultimately driven out by sal.

The effect of hostile relationship between the two species teak and sal is shown in its extreme form by the complete exclusion of teak from the States of Bonai, Bamra, Keonjhar and Sirguja and the adjoining tract of Bihar, where the annual rainfall is about

70 inches and the climatic climax is sal of moist type. High rainfall can neither be the dominant factor nor *the only* factor responsible for the complete absence of teak because teak occurs, in India, up to 150 inches annual rainfall (*i.e.* Travancore) and in Burma up to 200 inches. High rainfall affects only the frequency of teak in the mixture; the higher the rainfall the less the percentage of teak in the total crop. It is only when rainfall exceeds 200 inches that teak disappears *in toto* and is replaced completely by evergreen species. It is, therefore, clear that the elimination of teak from Bihar and the adjoining tract is not so much due to unfavourable physical (climatic and physiographic) factors as due to the disadvantageous reaction of sal. Personally, I consider the presence of sal to be the master factor responsible for this phenomenon. *The exclusion of certain species from certain parts of the earth is not necessarily due to adverse locality factors; it may also be due to the disadvantageous reaction of other plants which involves competition for light, moisture and nutrients.*

From the observations made, the following tentative conclusions may be safely drawn:

1. Mixture of teak and sal is only a passing phase. It is a transitory community and represents a seral stage in primary succession to the sal climatic climax.
2. In Kanker range the mixture is seen to occur only on drift soils and is characteristically absent, as a subsere, on soils formed *'in situ'*.

NOTE ON THE ABOVE ARTICLE

The Editor has asked me to read through Mr. A. B. Lal's article on the ecology of teak-sal mixtures.

The author recently qualified from the Ranger's College at Dehra Dun. He has selected a most interesting subject as his theme, and has produced a very stimulating article.

All successful foresters—from Conservators to Forest Guards—are practical ecologists, whether they realize it or not. Both the foundations and the superstructure of forest management are based on the sound practical interpretation of conscious and unconscious

observations on plant reaction to environment, impressions which are continually being registered in the observant forester's mind.

Unfortunately, the vast majority of these practical forest ecologists are mute; they make no record of the accumulated wisdom of their personal observations. In the case of many, experience and knowledge is something hidden away within themselves, a subconscious power which guides them successfully, but which they cannot bring forth as articulate reasoned argument. Others are more lucid, and have a conscious and reasoned logic behind their knowledge, but are withheld by modesty or procrastination from committing themselves to paper. Now this is a great pity, for to write about a worthwhile subject is of value to the writer as well as to the reader. In committing himself to paper the writer crystallises his own views, and may call forth helpful suggestions and criticism from others. The reader, we hope, will gain new information and clarify his own ideas.

Mr. A. B. Lal has written a very interesting note on the theme of the ecological significance of a teak-sal mixture. Obviously he has applied considerable thought to his subject and has been critically observant.

I found much to stimulate my interest and have looked out a number of references to make sure of points on which I was in doubt. I think the author tends to formulate general conclusions from a limited study of a particular locality. It is rash to suppose that conclusions arrived at as the result of purely local observations will be universally applicable to two such widely distributed and adaptable species as sal and teak.

Both species have an extremely wide distribution in India, and both are remarkably hardy and adaptable to variations of climate, soil and biotic factors. However, it so happens that the natural limits of distribution, though individually so wide, only overlap in a restricted area around parts of western Orissa and the eastern C. P. It is not easy to explain why the two species should be more or less segregated into separate regions, for the climatic and soil conditions throughout a great part of the zone of natural distribution of sal are reasonably suited to the growth of teak, and *vice versa*. Perhaps, it is largely a matter of chance. Both species have relatively heavy seed, and wide dispersal is a slow process, except

in as much as teak seeds may be carried to great distances by water. This feature may be of great significance as a controlling factor of natural distribution. I do not think there is anything inherently antagonistic between the two species; there are almost certainly combinations of climate and soil in India which would support a climax forest containing both teak and sal, if only the chance forces controlling natural distribution would operate to bring both species to the spot.

Incidentally, it is well to remember that over the moister areas of their natural range both teak and sal usually occur as units of a successional association or members of a biotic pre-climax. Serious deficiencies in natural reproduction, and difficulties in applying natural methods of regeneration cause acute problems of forest management over a surprising large proportion of the natural teak and sal forests of India. This reflects the ecological instability of the plant associations of those areas. Biotic factors, particularly fire, play a role of undoubted importance in the life of both species, more especially in areas with a moist climate; eliminate man, his cattle and his fires, and in the course of time the stocks of teak or sal would dwindle to insignificance or total extinction throughout much of the moister areas which they at present inhabit.

In the case of Kanker Range, apparently conditions are more particularly favourable to sal than to teak, and the aggressive exuberance of the sal is too much for the teak, which can only appear in a successional role. But conclusions drawn from ecological studies in Kanker can only be taken as indications of what may happen in other regions, where different soil, climatic and biotic factors predominate.

As a local study, Mr. Lal's article is a very good first effort. As his experience and judgment mature, he should turn out some first-class work, and we look forward to seeing him in print again.

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SUPPLY OF TIMBER FOR THE WAR FROM THE PUNJAB

BY R. S. CHOPRA

Introduction.—Timber as an essential munition of war needs no introduction. It is wanted for railway lines, bridges, barracks and temporary huts for housing large armies; for construction of motor bodies and gun carriages; for packing cases and ammunition boxes; and is used even in aeroplanes, underground and under-water structures and in many other ways far too numerous to mention. Soon after the outbreak of war timber was declared an essential war commodity in Great Britain. The demand for Indian timbers developed as the theatre of war shifted towards the mid-east. The Punjab lost no time in offering assistance and active co-operation to the Government of India in the matter of timber supplies. The Punjab Forest Department on the one hand arranged for extra fellings in Government forests to accumulate a war timber reserve and on the other it undertook purchase and inspection of timber on behalf of the Defence Department and its sawing and despatch according to the demand of the military authorities.

Timber inspection was started in February, 1940. By June, 1940, the army demand for timber increased beyond all expectations necessitating a special organization for the execution of work. Consequently, the Punjab Government sanctioned the creation of a special Army Timber Supply Circle with three divisions under its control in the first instance to which two more were added with further expansion of work in 1941. The management and working of this huge organization by the Punjab Forest Department is a landmark in its annals. The department was called upon to perform duties beyond its normal sphere but the supply of millions of cubic feet of timber is a living testimony of long and laborious hours ungrudgingly devoted by its officers and staff anxious to do their bit for winning the war.

The activities for war timber supply may be dealt with under the following heads:

(*a*) Supply of timber from Government forests.

(*b*) Purchase of timber in the market, its inspection and stocking.

(*c*) Organization and working of sawmills.

(*d*) Timber despatches.

(*e*) Accounting of timber.

(*a*) *Supply of timber from Government forests.*—The timber producing forests in the Punjab cover an area of about 2,000 square miles in the hills. The extraction of timbers from these remote forests in the Himalayas and its delivery in the plains, hundred of miles away from the source, even in peace-time is a strenuous work. The realization of an increased yield of timber in time of war, consistent with accepted principles of silviculture and maintenance of forest estate in perpetuity actually called for greater efforts. The army demand was largely for timber for temporary huts, packing cases, etc., for which timber of inferior species and of small dimensions was eminently suited. Sawing was, therefore, pushed on to the remotest corner of the hills into fire forests occurring at an elevation of about 8,000 to 11,000 feet as well as into areas where thinnings had been delayed due to peace-time limited demand. Thus by extensive and intensive working of difficult and distant forests the Punjab Government obtained large additional supplies of timber and supplied to the army thousands of tons of sawn scantlings and *ballies* (poles) in the first year of war, when little timber was available in the market. The price charged to the army was about 35 per cent. below market rates. Apart from this direct contribution in aid of war, the possession and holding up by the Punjab Government of the large reserve of timber helped materially in keeping down the rates paid by the Supply Department for timber purchased in the market.

(*b*) *Purchase of timber.*—The Punjab Forest Department could not meet the large army demand for timber from its own forests and had, therefore, to arrange for purchase of timber coming into the province from other places, from Kashmir State, the North-West Frontier Province, the Punjab hill states and the territory beyond the Indus as far as Swat and Kabul. The procedure followed is that the quantities of timber required for the army from time to time are communicated to the Chief Conservator of Forests,

Punjab by the Timber Directorate of the Department of Supply. The Chief Conservator institutes the necessary inquiries and advises the Timber Directorate of the probable quantity available and the prices. If these prove acceptable the department of Supply issues a purchase sanction specifying the quantities, rates, etc. The Chief Conservator then enters into purchase contracts with timber firms by issue of acceptance notes. In times of emergency the Chief Conservator is granted full powers of making purchases subject to 'limiting prices' agreed to in advance by the Supply Department. The Acceptance Notes lay down conditions of the contract including complete details of species, quantity, sizes, rate and quality of timber to be supplied, period of delivery, places of presentation and despatching instructions, etc. The quality of timber to be accepted has been defined in various army timber specifications (*reproduced in the Appendix*) which deal with timber defects and specify limits up to which particular defects may be accepted for various grades of timber.

The actual inspection of timber is carried out by the Timber Supply divisions as the suppliers offer timber. The passing of timber is a battle of wits between the supplying contractor and the passing officer. The contractor, a shrewd businessman as he is, leaves no stone unturned to minimise the defects in his timber. For him a knot is just a mole, and a crack just a scratch on the face of a sleeper. It is only by his seventh sense of detection that a passing officer is able to penetrate into the defects of the timber offered and occasionally there is a battle royal between him and the contractor or his agent over the merits and demerits of a particular piece.

The timber accepted is stamped with personal hammer of the passing officer, the species and specification hammers so that there may be no difficulty in the identification of passed timber and location of responsibility for acceptance should anything go amiss. For further facility in case of logs, the passed length, class and cubical contents are also painted with white paint on each log.

The passed timber at the commencement of the work was left with the suppliers till it was despatched either to military consignees or government sawmills. But this delayed payments to timber suppliers as they could only be paid bills on delivery of

timber in a government depot. Consequently, departmental storage depots were opened at main timber centres to receive all passed timber. The magnitude of the work can be gauged from the fact that timber worth over a crore of rupees has been purchased up to October, 1941, and forward contracts for the supply of far greater quantities have already been placed for supply in the next year beginning from winter, 1941. The purchase of such large quantities of timber at rates at least 30 per cent. lower than those prevailing in the market is entirely due to the indefatigable efforts and business acumen of Sir H. M. Glover, Kt., I.F.S., Chief Conservator of Forests, Punjab and the willing co-operation of the timber traders.

(c) *Organization and working of sawmills.*—To the army timber sawn to requisite sizes ready without further sawing, cutting, trimming, etc., for immediate use was a dire necessity and the Punjab Forest Department rose to the occasion to arrange for it. Side by side with the purchase of timber a number of sawmills were set up in different towns under the control of Timber Supply divisions. These sawmills have a sawing capacity of thousands of tons of timber annually. One of these sawmills alone produced a hundred tons of sawn timber daily. This sawmill is a unique and by far the biggest concern of its own kind in India. Walled with rough waste-wood it has a mysterious look. To the uninitiated it is a place of deafening roar while inside about half a thousand men play with saws and timber. They work both day and night and furnish a conspicuous example of Punjab's grit to help in the war. And the Punjab need not look elsewhere for hardy men but the speed of the work and the continuous strain have been much too much for some. At times some workers go away on the plea that the sawmill atmosphere does not suit them and surely that saw-laden, dust-laden atmosphere with a continuous ear-splitting din of saws is not a congenial place to work.

The sawmills have been installed on contract, *i.e.* the contractors have supplied machinery and installed it at their own cost and have undertaken sawing of timber on rates settled with them on contract renewable after six months. Sawing is confined to coniferous timber, *viz. deodar (Cedrus deodara), kail (Pinus*

excelsa, the Blue pine), *chil* (*Pinus longifolia*) and *fir* (*Picea morinda* and *Abies pindrow*, *i.e.* spruce and silver fir).

All sawing is done against indents issued by the Timber Directorate from time to time and distributed to the sawmills by the despatching branch of the Timber Supply Circle. The timber for sawing to meet such indents is issued from Government storage depots on requisition by the officer in charge of the sawmill. A daily sawing programme is drawn up at each mill keeping the priority of indents in view and careful watch is kept throughout, by the sawmill officer to reduce wastage to the minimum. After sawing the timber sawn is carried to passing benches where it is inspected, measured and passed by Government passing officers according to army specifications (*see* Appendix) and stamped as for timber purchased. The size is also written on each piece for sorting and stacking. The main classes under which sawn timber is classified are:

(*i*) *Selected timber (Grades I and II).*—Almost faultless timber reserved for supply to arsenals and ordnance or for use on special works, *e.g.* bridges, etc.

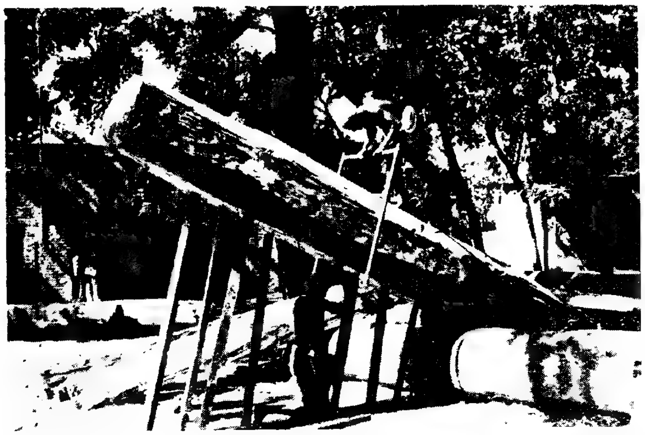
(*ii*) *Hutting specification.*—Good hutting timber with fewer defects for overseas supply.

(*iii*) *Karrie specification.*—Ordinary hutting timber.

(*iv*) *Packing case specification.*—Timber serviceable for crates and packing cases.

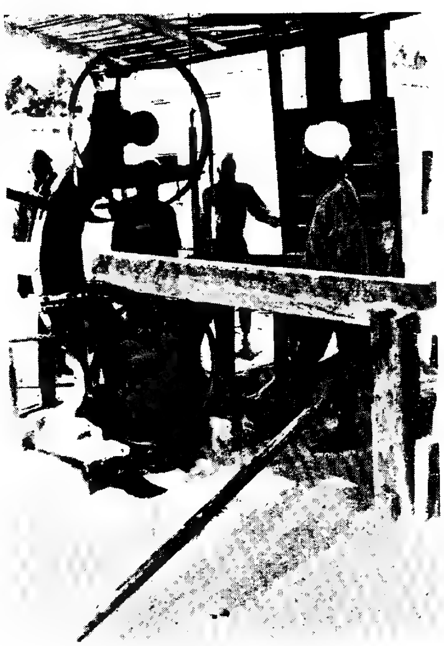
There are over 2,000 sizes to which timber is sawn. These sizes range from ½ inch to 12 inches in thickness and width and from 1 foot to 15 feet in length.

After inspection and passing the sawn timber is carried to the sawmill stacking yard and stacked by species, specification and sizes ready for despatch to military consignees. The sawmill wastage and sawn timber rejected in passing as below army specifications are sorted out and labelled as serviceable and unserviceable. Pieces useful for odd constructional works are supplied to the military and useless waste-wood is auctioned every week.

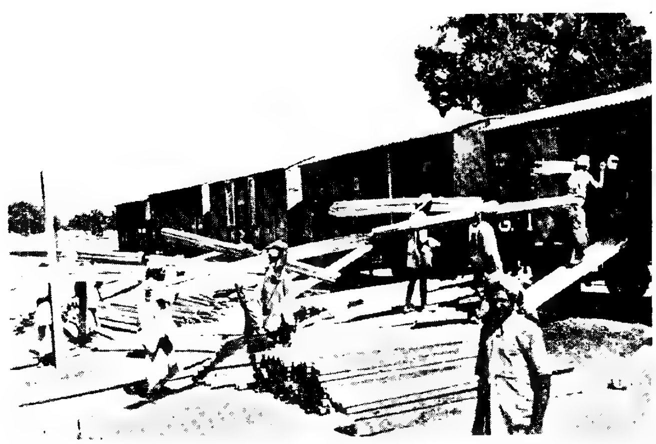


Quartering of logs.

Himalayan Fir Forests which are being extensively exploited in the Punjab for supply of timber for the war.



Sawing for Victory.



Despatch of mill-sawn timber to the army.

Sawing is paid for on the basis of volume sawn at rates fixed from time to time for sawing of logs and sleepers into *standard hutting sizes and *karries*. Special rates are fixed as the occasion arises for conversion of sizes not covered by the standard hutting sizes or in cases where more labour is involved. No sawing is paid for rotten or badly cracked or badly sawn pieces. The sawing rates include delivery of timber from the mill stacking yard to saw-benches and back, inspecting and hammer marking of sawn timber. The payment is further subject to wastage in conversion being kept within the following percentage limits:

	Deodar	*Kail*	*Chil*	*Fir*
Conversion of logs into hutting sizes	40	50	..	60
Conversion of sleepers into hutting sizes	30	35	45	45
Conversion of sleepers into *karries* by two saw-cuts	10	10	10	10

The power to waive excess wastage rests with the Conservator of Forests, Timber Supply Cirlce, Punjab, and is exercised only in exceptional cases where cogent reasons exist for doing so.

The sawmills are a new experience for the Forest Department hardly in line with the training of forest officers who in organizing and working the sawmills had suddenly to switch on to a new gear. The entire staff for the sawmills had to be trained from the very beginning and the training of young men required considerable tact drive, patience and industry. But the establishment of big sawmills in about three months' time speaks for the rapidity with which the Punjab Forest Department has adjusted itself to changed needs in the time of war (*see* Plate 13). The name of Mr. N. P. Mohan, I.F.S., deserves a particular mention for laying down the

* Standard Hutting Sizes

Thick (inches)	Width (inches)	Length	Percenta e
¾ ..	4, 5 and 6	6′ and over with 75% abo e 8′ as long as possible ..	5%
1 ..	4, 5, 6, 8 and 9		10%
1½ ..	4		30%
	5, 6, 8 and 9		10%
2 ..	4		10%
	5, 6, 8 and 9		10%
3 ..	6 and 8		5%
4 ..	4		5%
	6 and 8		5%
5 ..	8 and 10		5%
6 ..	6 and 12		5%

foundations of the biggest sawmill and devising a sound organization for its working. It may also be mentioned that for the sawing contractors, too, it was a venture in the dark, for big sawmills were unknown in the province; but they have co-operated as willingly and heartily as may be expected of any loyal citizen and are doing the work at very reasonable rates allowing themselves a narrow margin of profit.

(*d*) *Timber despatches.*—The despatches are regulated by indents received from Timber Directorate. The work is controlled by a despatching officer in the Timber Supply Circle who distributes supply orders to different supply divisions and keeps a watch on the timber despatched from time to time. The despatch of timber particularly the mill-sawn material presented a difficult problem owing to multiplicity of sizes, species, specifications and indents coupled with high speed of work. The timber between issue from Government depot to loading in the wagons is checked and counted several times to guard against wrong despatches. The job of the loading officer is not at all enviable. He has of necessity to train himself to such a high pitch of efficiency that he must correctly size up a wagon by mere look and keep an accurate record of the number of pieces by sizes, species and specifications that go into it. There have been few who have specialized themselves to that degree. It is easy to estimate the space in a few cases and keep account for a short time, but to do it continuously day in and day out, hour after hour is nerve-racking. It is surprising that there has been no actual case of nervous breakdown unless one takes frequent resignations as symptoms of nervous disorder.

The consignments (booked under military Credit Notes) are covered by Inspection, Loading and Receipt Vouchers issued by the supplying divisions for acknowledgment of the consignees but a preliminary invoice is sent with the railway receipt and a convoy note placed in each wagon for ready check at the consignee's end. Copies of these vouchers giving complete details of timber despatched are also supplied to the military audit and control units for linking and watching the progress of supplies. The last stage is a completion report submitted by the supplying division to the Timber Supply Circle and the Timber Directorate when supplies against a particular order are completed.

(*e*) *Accounting of timber.*—Side by side with different timber operations is the maintenance of accurate accounts. It is a laborious and complex affair. Each piece has to wend its way through a maze of account books and forms. The Government of India, Defence Department, on whose behalf the work is being carried out,

have laid down a broad procedure governing payment and accountancy arrangements. Within the framework of this procedure, accounting system has been organized on the lines familiar to the forest staff. Major payments for purchase, carriage and sawing of timber are made direct to the contractors by the Controller of Supply Accounts on the strength of bills certified by the divisional forest officers under whom the work is done. Minor work payment, staff pays and contingencies, etc., are made by the Punjab Government and finally adjusted with the Government of India. Timber accounts of storage depots and sawmills are audited quarterly by military auditors. In addition, fortnightly progress reports and monthly abstracts of receipts and disposals of timber (Forest Department Timber Form No. 7) are submitted by the divisional forest officers to the Conservator in whose office the data are co-ordinated and consolidated by an Assistant Accounts Officer for ready reference and supply of information to the Timber Directorate.

Timber purchase accounts are kept by Acceptance Notes issued in favour of different suppliers. After passing as soon as the timber is delivered by the supplier in Government storage depot or despatched under supervision of forest staff to outstations, the divisional forest officer concerned issues an Inspection, Loading and Receipt Voucher for the quantity which forms the basis of payment to the contractor for the supplies. In the case of timber despatched to outstations 80 per cent. payment is made in the first instance and balance 20 per cent. on production of consignees' acknowledgment.

Stock account in storage depots are maintained on standard forest department timber forms modified to suit special requirements, but the sawmill accounts are of an intricate nature. A very detailed sawing account is maintained. Each and every piece sawn is entered in the daily passing registers at the time of inspection and passing. The daily sawing and despatch account has to undergo an elaborate process of consolidation to put it into a readily intelligible form. I better refrain from inflicting on the readers any more details of accounts because even at the best of times and with best intentions they lead a sane man into temporary fits of confusion and wool-gathering.

Such, in brief, is the general outline of the organization behind the supply of timber for war from the Punjab—an organization which has supplied lakhs and lakhs of cubic feet timber already, and is strong and sound enough to double or treble its output.

APPEN
ARMY TIMBER

Specification No.	Applicable to	Defects — Knots — Live	Defects — Knots — Dead	Defects — Cracks, Shakes — Straight
1	2	3	4	5
				(a) FOR CONIFEROUS
				(i) *Logs, Ballies*
TM-166	Logs.	Up to 2″ diameter permissible. Every knot 2″ to 4″ diameter to count as one defect, 4″ to 6″ diameter as 2 defects and 6″ and over in diameter as 3 defects.	..	*Shakes.*—Cup shakes not permissible if occuring at both ends. Permissible at one end if not serious subject to cut measurements. Star shakes permissible subject to cut measurements. *Splits.*—Longitudinal splits over 3″ deep not permitted. Each split ¾″ to 3″ deep to count as one defect. End splits acceptable subject to cut measurements.
T.D-1/8/41 and T.D. 41 dated 13-10-41.	Ballies or poles.	Knots live or dead not to exceed ⅓rd diameter of the pole at the point where they occur and should not be numerous or so grouped as to reduce the strength of the pole.	..	Cracks and shakes should not be deep, long or numerous as to weaken the pole unduly.
T.W./7 of 1939	Deodar spars or logs for S & M use, or other purposes.	Diameter of knots not to exceed 1/5th the diameter of the spar or log at the places where they occur and knots must not be so numerous or so disposed as to weaken the piece unduly. Knots in spars should be trimmed flush with the surface and all excrescences made smooth.	..	Cracks must not be deeper than 1½ inches or wider than 3/16 inch.

DIX

SPECIFICATIONS

PERMISSIBLE					
and Splits	Sapwood	Centre-heart	Surface defects	General	Permissible tolerance in measurement
Oblique					
6	7	8	9	10	11
TIMBER, *VIZ.* DEODAR, KAIL, CHIL AND FIR					
(Poles) and Spars					
..	..	..	..	Decay and rot not permitted in heart wood. Tapering ends and double skin acceptable subject to cut measurements. Unshapely, badly curved and plugged logs to hide defects not acceptable. *Quality of logs.*—I class logs not to contain more than 3, II class more than 5, and III class more than 8 defects per 10 c.ft. of volume.	Girth measured in the middle of acceptable length excluding bark. In doubtful cases mean to be taken of measurements at the big and small ends. Measurements taken correct to 1" for girth and 3" for length-volume worked out by (¼ girth)² formula.
..	.	..	..	Poles to be free from decay, rot or harmful fungi or insect attack, twist, kinks, spongy or brittle conditions. Bark to be removed before presentation. The axis of the pole not to deviate from the straight by more than 1" per 5 feet of its entire length in case of T. D. 1/8/41, and 1" per 4 feet of its length in case of T. D. 41 dated 13-10-41.	Measurement done as per logs under TM-166.
..	..	..	..	Spars and logs shall be free from any insect attack, visible rot or spongy or brittle timber and twisted fibre. Shall be selected from stocks kept in the depot for not more than 6 months. Bark to be removed before presentation. Spars and logs must not deviate from the straight by more than one per cent. of their length. Deviation to be uniform.	Tolerance of ±1" in diameter allowed Lengths shall be as ordered. Volume measurements by the system of quarter girth squared as for logs excluding bark.

APPEN

1	2	3	4	5
TAO 4/4/40	Scantlings and planks for hutting.	*For scantlings.*—Not to affect more than $\frac{1}{4}$ of the area of the section of the piece at the place of occurrence, maximum up to $\frac{1}{3}$ of the area at the discretion of the passing officer. *For planks.*—Circular knots on broad face not to exceed $\frac{3}{8}$th the width of the face subject to maximum average diameter $2\frac{3}{4}''$. Cut knots not to affect more than $\frac{3}{8}$th of the distance across and $\frac{1}{2}$ the width of the plank. Spike knot not to affect more than $\frac{1}{4}$ area of the section of plank. Numerous knots not acceptable.	Not to affect more than $\frac{1}{8}$th of the area of the section of the piece at the places they occur. Maximum diameter $1\frac{1}{4}''$. Maximum diameter $1\frac{1}{4}''$.	Permissible on faces up to 2′-6″ in length. Through cracks permissible in the ends up to a total for both ends of $\frac{1}{2}''$ per foot length of the piece.
TAO 11 of 1936	Unseasoned deodar sleepers.	Knots under 1″ diameter may be neglected 1″ and over maximum number permitted per piece =5, provided not more than 2 are of maximum size. Maximum size—2″ and 3″, respectively, as described under dead knot. Knots so concentrated or grouped as to reduce strength of the piece more than 35% of normal strength not permissible.	Knots under $\frac{1}{2}''$ diameter may be neglected. $\frac{1}{2}''$ and over maximum number permissible=3. Maximum size of knot $\frac{3}{4}''$ diameter perpendicular to grains or length, and 1″ across the largest diameter of the exposed face of the knot measured parallel to the exposure.	Permissible at the ends up to a total for both ends of $\frac{1}{2}''$ per foot length of the piece. On broad faces up to 2′ in length for anyone crack, provided it does not join or appear to join any crack on the opposite or adjoining face. On narrow faces up to 6″ in length and $\frac{1}{2}''$ depth with the proviso as for broad face. Through cracks from one face to another inadmissible. Numerous cracks forbidden.

DIX—*contd*

6	7	8	9	10	11
				Taper.—In any 15′ length of the spar or log the diameter at the thin end should not be less than 4/5th of the diameter at the thick end. For lengths shorter than 15′, the diameter at the top shall in no case be less than 4/5th diameter at the butt.	
(ii) Sawn Timber.					
Inadmissible.	Permitted up to ¼th of the section of the piece if sound.	Not permitted.	..	Timber to be of reasonably straight grain free from spongy or brittle condition, rot and harmful insect damage. Pieces to be sawn straight and parallel, of rectangular section, square trimmed at the ends.	±⅛″ in thickness and width over-size in length at discretion of passing officer. Undersized only for 10% of the lot. *Warp*.—1% of length of the piece.
Inadmissible.	To be free from cracks, shakes and fungi or insect attacks. Permissible on one broad face up to ⅓rd the face width. If occurring on both faces then up to ⅓rd width on one face and up to machining allowance on the other. Machining allowance is ⅛″ in width, ⅛″ in thickness and ½″ per foot of length.		Axe marks, dents depressions, permissible up to machining allowance.	As for TAO 4/4/40. Discoloration of light green colour or due to sun permissible if not occurring opposite a crack or shake. Discoloration of dark green or voilet colour or any sign of decay inadmissible. Resin streaks permissible if not likely to develop into cracks. Resin pockets permissible upto 3″ in length and ¼″ in depth. Strength to be at least 65% of the average Dehra Dun test piece. Ends to be coated with thick oil No. 835-B of Vacuum Oil Co., and end cracks over 2″ in length to be treated with small metal clamps.	Minimum size 9′×10″ ×5″ and Maximum 12′×11″×6″

APPEN

1	2	3	4	5
TAO 3(a) of 1936	Unseasoned converted deodar timber.	Size limits as for TAO-11 of 1936. Maximum size shall be reduced to ½ for knot occurring within 1½″ of the edge and raised to 3″ from 2″. For pieces 14′ and up in length and 2″ up in thickness maximum number permissible 10 knots, provided not more than 4 are of maximum size. Grouping, etc., as for TAO-11 of 1936.	Size limits as for TAO-11 of 1936. Maximum number permissible 5, provided not more than 3 are of maximum size. In case of pieces 14′ and over in length or 2″ and over in thickness maximum size shall be raised to 1″ instead of ¾″ diameter perpendicular to grains.	Do.
TW-4-39	Scantlings for general purpose.	Average diameter not to exceed ⅓rd the width of the face reduced to ¼th in case of knots occurring within 1½″ of the edge of the piece. Numerous badly grouped knots inadmissible.	Average diameter not to exceed 1/5th the width of the face.	Permissible in the ends up to a total for both ends of ¼″ per foot length of the piece and on faces ½″ in depth, provided no cracks appear likely to join any other face
TAO/7/8/40	Karries (in lieu of ballies.	Should not unduly affect strength of the piece.	Should not unduly affect strength of the piece.	Should not be so long and deep and numerous as to weaken the piece unduly.
TAO/9/3/41	Sleepers and beams for packing cases.	Permissible without limit subject to condition of outturn as under head "general"	..	Permissible at the ends up to a total length of 1″ per foot length of the piece. On broad and narrow faces up to 1½″ depth and without limit of length, subject to condition of outturn as under head "general."
TAO-10/4/41	Grade I and II special sleepers 9′ and up, 10″×6″, for conversion to planks for M.T. works.	Live knots under 1″ diameter negligible, and over 2″ diameter not allowed. Not more than 5 knots of 1″ to 2″ diameter for 9′ or 10′ sleepers allowed. Knots larger than 2″ diameter may be accepted taking position of knots into consideration with respect to expected outturn of sawn timber as given under head "general." In Grade I sleepers, larger knots with-	..	Permissible up to 2½′ in length, provided that no crack is likely to join any crack on any other surface. Cracks should not unduly affect the strength and utility of timber when converted. End cracks permitted to the extent that after deducting the crack a 9′ sleeper should not measure less than 8′-8″ and 10′ sleeper less than 9′-7″.

DIX—*contd.*

6	7	8	9	10	11
Inadmissibile.	As for TAO-11 of 1936.	..	..	As for TAO-11 of 1936.	Over-size in length permissible without limit, and in width and thickness up to ½″ and ¼″, respectively. Under-size permissible up to ⅛″ per ft. of length in uncracked wood, up to ⅛″ in width and 1/16″ in thickness. Over size not paid for.
Do.	As for TAO 4/4/40	Not permitted.	..	As for TAO 4/4/40.	
..	..	Permissible.	..	Timber to be sound of good quality, free from decay, rot, harmful insect or fungi damage, pronounced twist and spongy or brittle condition and crossgrain.	1/16th tolerance permissible in thickness and width subject to a maximum of ¼″. Warp allowed 2″ per 12′ length.
Inadmissible.	Permissible without limit if sound.	As for sapwood.	..	As for TAO 7/8/40 subject to the condition that defects do not prevent recovery of 50% of the volume of the piece in serviceable packing-case timber, if sawn into 4″ and up, wide by 1″, and ½″ thick boards and 2′ long and up.	
..	Permissible if absolutely sound.	Not permitted.	..	Timber shall be of good quality free from warp, twist or bend, decay, rot, harmful fungi or insect attack and a spongy or brittle condition. Sleepers shall be partly sawn or axed and free of serious end damage. General quality of sleepers must be such that not less than 66⅔% of outturn in 1″ boards free of cracks and of really high quality shall	

APPEN

1	2	3	4	5
		in 6″ of the end of a 9′ sleeper is not likely to affect the outturn in planks. For Grade II sleepers, live knots up to 2¼″ diameter could be accepted against 2″ diameter for Grade I.		
TD-4/8/41	Sleepers for conversion to hutting timber.	Maximum size permissible 2¾″ average diameter. Knots numerous or so disposed as to unduly affect the strength and sawn outturn.	Maximum permissible diameter 1¼″ measured across the face. Below ¾″ diameter negligible. Maximum number of ¾″ to 1¼″ diameter knots 3.	After deducting and cracks the sleepers must not measure less than 9″ short of the ordered length. Cracks should not unduly affect strength of the piece and sawn outturn.
C	I Class railway sleepers.	*Maximum size.*—1″ diameter for knots occurring within 6″ from centre of rail seat and 3″ diameter for V. G. and 2″ for M. G. and N. G. sleepers for knots away from rail seat. Only one knot of maximum size allowed near rail seat and knots away from rail seat should not be so grouped as to materially affect the strength.	..	..

DIX—*contd.*

6	7	8	9	10	11
				be obtainable on conversion. I Grade special sleepers should produce at least three, 8" or wider planks, 1" thick and 8½" long or longer free of live knots larger than 2" diameter and any cracks not acceptable under TAO-4/4/40. The remainder of outturn required to make up 66⅔% may be in 4" wide or wider planks × 2′ long or longer × 1" thick of some high quality. II Grade sleepers are expected to produce 50% outturn of planks of similar high quality as for Grade I, 20 running feet of 8" or wider planks each piece 5′ long or longer and the balance of the outturn required to make up 50% in 4" wide or wider planks × 2′ long or longer of the same high quality.	
..	Permissible if sound.	Not permitted unless definitely permitted in the order.	..	Timber to be good clean quality free from warp, twist, decay, rot, harmful insect or fungi attack and brittle or spongy conditions. Pieces shall be straight, well sawn and free from serious end damage. General quality should be such that not less than 60% outturn of TAO-4/4/40. specification is obtained in the form of pieces of 4"×2" section 6′ and up in length average 8′-6′.	..
..	In case of deodar not more than 10% at any section and one broad face entirely free. For fir, *kail* and *chil* no limit.	Heart-centre included in both ends of a sleeper not permitted. When occurring at one end or sawn through, heart-centre should not occur further than 1¼" from the nearest edge of the sleeper. Annual rings should not be perpendicular to broad face.	..	*Wane.*—1" wane is allowed. In case of deodar it should not cause an excess of 10% of sapwood. *Twisted fibre* (for *chil* only.).—At least 20% of the fibres must run through whole of the sleeper or either broad or deep faces. Within this limit the fibres starting from top corner at one end of the sleeper should finish at above 2" from the bottom corner at the other end in case of broad face and 1" for deep face.	*Spring.*—Maximum allowed : 2" for 9′ ×10"×5" sleepers and 1¼" for 6′× 8"×4½" and 5′×7" ×4½" sleepers. *Cup.*—Maximum allowed ½" for B. G. and ¼" for M. G. and N. G. sleepers. *Winding.*—Allowed to the extent that adzing maximum required to seat the bearing plates does not exceed ¼" in depth.

APPEN

1	2	3	4	5
			(b) HARD WOODS, *e.g.* SHISHAM, TEAK	
				(i) Logs
Gun Carriage Factory Specification No. 2816	Logs.	Up to 2″ in diameter in reasonable number no defect, 2″ to 6″ in diameter a minor defect. 6″ to 10″ in diameter allowed up to 2 in number if they occur not nearer than 10′ from butt end of a log. Knotty oblique logs, *i.e.* those containing numerous knots not accepted.	Up to 2″ in diameter minor defects if not more than 4 in 10 running feet. Over 4 in number and 4″ in diameter a major defect.	A split under 8″ deep no defect, 8″ to 12″ deep a minor defect, and over 12″ deep a major defect. If more than one cup shake, 3 heart and 6 radial shakes occur, minor defects become major defects.
				(ii) Sawn
10-F specification 2819.	Planks for Gun Carriage Factory.	Live knots to the extent of one per 2 square ft. permissible. A knot over 2″ in diameter a major defect. A few pin knots accepted. Grouping of knots should not unduly affect strength of the plank.	Dead knots a major defect.	Splits may be accepted subject to cut measurements.
TD 2/8/41	*Shisham* sawn timber.	Maximum size 1½″ diameter, but average diameter not to exceed ¼th the measurement of the side on which it occurs and no knot to affect more than 1/6th the area of the section of the piece at the place it occurs.	Permissible if superficial and unlikely to affect utility or strength of the piece.	Cracks at the ends permitted up to a total for both ends of ½″ per ft. length of the piece. On the faces only superficial seasoning cracks permitted.

DIX—*concld*

6	7	8	9	10	1
SAL, ETC.					
..	..	..	..	*Lack of straightness.*—In 10′ up to 3″ out of straight no defect. 3″ to 6″ minor defect, over 6″ major defect. *Taper.*—1¼″ in 10′ for every 12″ diameter at the butt permissible. *Wounds.*—Bark pockets, bird packs and other wounds up to 1½″ in depth in mature wood a minor defect. Above 1½″ in depth and 2″ in diameter in mature wood a major defect. Internal wounds (including hollow centre) up to 1/12th the diameter of the log a minor defect, above this limit a Major defect. *General.*—Logs to be of recent fellings reasonably straight free from twists, large branch junctions, spongy, heart-centre, dry, rot, etc. *No. of defects permitted.*—Minor defects up to 4 in number.	*Minimum size.*—10′ length and 54″ mean girth. Length to be measured from the first felling cut extending farthest into length from the butt end to the nearest cut of the top end. Girth taken in the middle excluding bark and protuberance. For tapering logs mean of three girths taken at the centre and the two ends to be taken. If bark is not removed a minimum deduction of 1″ per foot of girth will be made. Logs down to 6′ length also accepted provided there is an increase in mean girth of 4″ per foot of reduced length below 10′ and such logs do not exceed 2 % of the supply.
Timber Not to exceed 5% of volume.	..	..	..	Planks to be cut perfectly straight and parallel and should be free from warp, twist, plugs, rough grain, splits, decay, or dry rot. Edges may be untrimmed. Planks with minor defects should be accepted subject to cut measurements, the accepted measurement, should be stamped on the plank. Timber to be supplied unseasoned.	+¼″ tolerance permissible in width and thickness but no under-size. *Sizes.*—Thickness 3-½″. *Length.*—25% not less than 7′, 25% not less than 6′ and the rest not less than 4½′. *Width.*—25% not less than 10″, 25% not less than 8″ and the rest not less than 6″.
Pieces of 8 sq. inches or less sectional area to be entirely free of sapwood. On pieces of larger sections sapwood, if present, should not affect more than 2½% of the sectional area of the piece	Not permitted unless definitely permitted in the order.	As for dead knots.	..	Timber to be sound, free from warp, twist or bend. Pieces to be straight, sawn parallel, square edged and square trimmed at the ends. Grain to be reasonably straight. Ends of pieces to be coated with oil to slow up drying and reduce cracking.	Over-size permitted at the discretion of the passing officer. Under-size permissible ⅛″ in width and 1/16″ in thickness and no under-size in length.

NAME CHANGES IN IMPORTANT INDIAN PLANTS

BY M. B. RAIZADA, M.SC., ASSISTANT FOREST BOTANIST,

Forest Research Institute, Dehra Dun.

The following information is of importance to those who are interested in Indian botany:

The latest issue of the Journal of the Arnold Arboretum XXII (1941), a copy of which has just been received in the Library of the Botanical Branch, contains certain new names proposed by Alfred Rehder, Curator of the Arnold Arboretum herbarium, which affect some of our well-known forest plants. According to him the correct name for the tree *Quercus dilatata* Lindley which is widely distributed in the western temperate Himalaya from Kumaon to Kashmir, 4,500—9,000 ft., should be *Quercus floribunda* Wall and *Clematis nutans* Royle (vern. Nak-chikni), a climber common in the sub-Himalayan tract up to 5,000 ft. is to be called *C. roylei* Rehder. His arguments briefly put forth are as follows:

Quercus floribunda Wallich, Num. List no. 2773 (1830), nom. nov.

Quercus dilatata Lindley ex Wallich, Num. List no. 2785 (1830), nom. nud.—Royle, III. Ill. Bot. Himal. 346, t. 84, fig. 2 (1839), nom.; "*Q. dealbata*" sub tab.—A. de Candolle in DC., Prodr. 16, 2: 41 (1864).—Hooker f., Fl. Brit. Ind. 5: 602 (1888), non Refinesque (1838).

Quercus floribunda Wallich, Num. List no. 2773 (1830), nomen nudum.

The name *Q. dilatata* Lindl. was not validly published until 1864 by A. de Candolle (l.c.). In 1839 it was mentioned by Royle (l.c.) and a coloured figure of a fruiting branch published, but without description. According to Royle De Candolle (l.c.) and Hooker f. (l.c.), the figure bears the name "*Q. dealbata*" but in the copy in the Arboretum Library (and the Botanical Branch Library of the F.R.I.), the name on the plate is *Q. dilatata;* one can see, however, that the plate is apparently of a later issue in which the legend of the plate has been changed.

The name on the plate has inadvertently been placed as *Q. dealbata*.

Since the name *Q. dilatata* was not validly published until 1864 it is a later homonym of *Q. dilatata* Rafinesque, Alsogr. Am. 24 (1838) which must be considered validly published though the description is rather incomplete, being based only on vegetative characters. Rafinesque's species seems to fit best *Q. marilandica* Muenchh. to which it has been referred as a synonym by Trelease, Am. Oaks, 199 (in Mem. Nat. Acad. Sci. 20: 199) (1924); he also refers to it doubtfully under *Q. stellata* (p. 104). The name is not mentioned by Sargent in his Silva.

For *Q. dilatata* Lindl. ex De Candolle which must be rejected as a later homonym, the name *Q. floribunda* Wall. may be taken up, represented by his No. 2773 which entered into the original description of *Q. dilatata* as given by A. de Candolle. The epithet "floribunda" does not seem to have been used either in *Quercus, Pasania, Lithocarpus* or *Synaedrys* and its adoption, therefore cannot be expected to cause any confusion.

To designate as *nomen novum* an old *nomen nudum* taken up in place of a name rejected because not conforming to the rules, may not seem literally correct, but having never before been used as a valid name of a species, it must be considered new from a nomenclatural point of view.

Clematis roylei Rehder, nom. nov.

Clematis nutans Royle, Ill. Bot. Himal. 51 (1839).—Hooker f. & Thomson, Fl. Ind. 1 : 10 (1855).—Hooker f., Fl. Brit Ind. 1 : 5 (1872).—Kuntze in Verh. Bot. Ver. Brandenb. 26 : 129 (Monog. Clem.) (1885), non Crantz (1763).

Clematis nutans α. normalis Kuntze, l.c. (1885).

As *Clematis nutans* Royle is invalidated by the earlier homonym *C. nutans* Crantz, Stirp. Austr. 2: 110 (1763); ed. 2, 1: 127 (1769), the species has to receive a new name. Although *C. nutans* Crantz is illegitimate, being a renaming of *C. integrifolia* L., the later homonym is to be rejected according to Art. 61 of the International Rules of Botanical Nomenclature.

TRANSPLANTING OF SAL IN TILKONIA RANGE, GORAKHPUR DIVISION

By Jalil Ahmad Kuraishy,

Forest Ranger

The Coppice system having failed to regenerate nearly a quarter of my range, we were confronted with the problem of regenerating a large area and in double quick time so as not to lose valuable increment, having already slept too long over the matter. Since sal seed is notorious for its poor keeping quality and an erratic monsoon was the order of the day, transplanting was resorted to under the guidance of the D.F.O., Mr. M. J. McDonald, as it appeared to be the only method by which we could successfully regenerate the area in one and the same year. Heartened by the fact that large trees could be moved about in some gardens in certain parts of the world, we set to work and transplanted a large number of sal seedlings about six weeks old in coupes XII and XIII in 1939 (July and August) from specially prepared small nurseries near water taps and wells and from dense patches in the lines. Halfround hoes of 6 ins.—9 ins. blades were specially made and the plant was gently taken out and planted into a previously dug hole with the least possible disturbance and shock to it, taking care to pack the roots of the planted seedling well. The results were beyond our most sanguine hopes and convinced us about the definite possibility of this method being employed on a large scale (*see* Plate 14, Figs. I and II). In fact right from the very beginning I was so sure of success that on July 21, 1939, when the Extra Assistant and two Range Officers of the division were out inspecting this work during the auctions, I deliberately cut down the roots of 5 plants and planted them out in a field as against dug-out and work-trench soil and four of them are still going strong, the fifth having been trampled down by tenants as they were put in too close to a footpath. I had done this to convince them that even with some mishandling, it was possible for the plants to grow up provided the operation was done quickly and the soil was well moist. As a check in 1939, 300 transplants were pegged out in coupes XII and XIII for observation and the last observation record-

Fig. I

Sal transplants replacing individual failures in a sown line in the 1940 *taungya*, Expt. 4, Coupe 22, Ramgarh Block, Gorakhpur Division.

Photo: A. L. Griffith. 6-12-41.

Fig. II

A line of sal transplants filling up a large gap in the sown lines in the 1940 *taungya*, Compt. 3, Coupe 24, Tilkonia Block, Gorakhpur Division.

Photo: A. L Griffith. 5-12-41.

ed after a terrific hot weather and erratic monsoon on 1st August 1940, showed 164 plants still living *i.e.* 55 per cent. success. I should think even sowings do not show better results, as when sown wing to wing and in double rows every chain length of a trench takes about 800 sal seeds and not more than 33 per cent. ever survive as plants in the second year. With experience gained, better and longer hoes (15″—18″ blades) were prepared in the 2nd year and transplanting, if now done with care and in proper weather, gives 100 per cent. success. This can better be seen on the spot than believed. Filling up of blanks on a large scale has thus been practically demonstrated and since the plants have not yet shown any ill effects, there is no reason why they should not continue to behave like any seedling plant grown *in situ*. Thanks to this method I have been successful in doing about 550 acres annually of *taungya* sowings for the past two years despite unfavourable and deficient monsoon, and I am happy that no large blanks are to be found anywhere in my areas.

This note is written as up to now it was considered impossible to transplant sal on a large scale.

The Central Silviculturist, Forest Research Institute, Dehra Dun, visited Gorakhpur Division during his tour in November, 1941, and inspected the actual work done there in the above connection. We had passed this article on to him for his remarks and he has very kindly sent us the two photographs of Plate 14 in this issue of the sal transplants in Tilkonia Range with which we have illustrated the article. The Central Silviculturist observes that "the failure of coppice regeneration in Tilkonia Range has been due to various causes. The transplanting of sal to fill in blanks in Tilkonia Range has been very successful, but it is a laborious and expensive process and only possible with keen forest villagers doing the *taungya*.

"The lines in the sal *taungyas* are 15 ft. apart and 2 rows of seed are sown in each line. One row is sown deep and the other is sown shallow, but both rows are sown at the same time. This attempts to allow for bad patches in the weather at or soon after the time of sowing, but does not allow for bad patches in the seed (which are usual with sal seed collections).

"The blanks in the sal are noticeably in patches and are generally not of individual plants in the rows. It is quite possible that the rotational sowing of 3 rows in each line as is current practice in Bengal would tend to prevent the blanks and be cheaper and easier to do than transplanting. It would, however, mean a greater seed collection."—*Ed.*

TIMBER PRICE LIST, FEBRUARY-MARCH, 1942

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 38-0-0 per ton.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 48-0-0 to 115-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 66-6-0 to 84-6-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 72-0-0 to 130-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-7-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 8-2-0 to 8-9-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
,, ..	,, ..	Punjab ..	10′×10″×5″ ..	Rs. 4-0-0 to 6-10-8 per piece.
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	Re. 1-6-0 to 2-8-0 per c.ft.
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 6-0-0 to 8-12-3 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	Rs. 88-7-0 to 92-5-0 per ton.
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	Rs. 3-0-0 to 6-0-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
,, ..	,, ..	Assam ..	Squares ..	Rs. 100-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	Rs. 65-0-0 per ton.
,, ..	,, ..	Bombay ..	Squares ..	Rs. 32-0-0 to 80-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	
,, ..	,, ..	Madras ..	Logs ..	Rs. 43-12-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-9-0 to 0-12-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers ..	Rs. 7-0-0 each.
Indian rose-wood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 68-0-0 to 160-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 135-10-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	Rs. 69-0-0 per ton.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 65-10-0 to 87-8-0 per ton.
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 85-0-0 per ton.
,, ..	,, ..	P. ..	Squares ..	

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bihar ..	Logs ..	Re. 0-9-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 55-3-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 7-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 1-10-0 to 3-4 6 per c.ft.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 35-0-0 to 100-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-4-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-14-0 each.
,, ..	,, ..	Bengal ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-7-0 to 1-4-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers..	
,, ..	,, ..	,, ..	M. G. sleepers..	
,, ..	,, ..	C. P. ..	Logs ..	
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-10-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 2-8-0 to 2-12 0 each.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 1-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-12-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Re. 38-0-0 per ton.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 0-8-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 1-6-0 to 1-8-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Re. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	
Sundri ..	*Heritiera* spp. ..	Bengal ..	Scantlings ..	
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class..	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	
,, ..	,, ..	,, ..	Squares ..	
..	,, ..	Madras ..	Logs ..	Rs. 65-10-0 to 120-5-0 per ton.
..	,, ..	Bombay ..	Logs ..	Rs. 88-0-0 to 340-0-0 per ton.
..	,, ..	,, ..	M. G. sleepers..	Rs. 6-0-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

ACACIA LEAUCOPHLOEA AND *ACACIA ALBA*

SIR,

I have read with great interest Mr. Cherian Jacob's article in the *Indian Forester* for January, 1942. I believe both the varieties of the *Acacia* mentioned by Mr. Cherian Jacob are found in the Telugu Districts of Madras Presidency and in Ganjam which prior to the formation was included in the Madras Presidency, but has since been transferred to Orissa. In fact *A. leaucophlœa*, if any thing, is more commonly found.

These trees are often found growing side by side as avenue trees on some of the District Board roads in the Ganjam District.

Yours faithfully,

(Khan Bahadur) SAIDUDDIN AHMED,

District Forest Officer,

Ghumsur South Division.

RUSSELKONDA,
30TH JANUARY, 1942.

REVIEWS AND ABSTRACTS

HOW TO GROW *SHISHAM (DALBERGIA SISSOO)*

BY P. N. DEOGUN,

Divisional Forest Officer, Montgomery Forest division,

Chichawatni, Punjab.

Pages 1—4 and 1—13, 2 plates. Price Re. 1

This is an addition to literature relating to *Shisham*. *Shisham* plantations have the advantage of a comparatively short rotation.

2. There is no lack of evidence of the author's keenness in making the planting of trees popular among villagers, to which set purpose he has written and printed the pamphlet at his own expense!

3. The main object of the publication is to guide planters and to remove wrong ideas. The latter is especially catered for under "dont's". To these perhaps a few more could be added, *e.g.* "don't plant stumps when it is actually raining."

4. The author remarks that *Shisham* is a fool-proof species. We surmise he has excluded the errant who plants on land not

legally his own. This is a first requisite to make sure of in planting by villagers, and needs stressing.

5. The writer alludes to his experiments which have shown that the species can be made to reach subsoil moisture within a couple of years. It will be interesting to hear of the experimental details. Were the experiments statistically acceptable?

6. The pamphlet is obviously meant for local consumption. The outsider would like terms such as *pasel, patri* and *khal* annotated to follow the directions with profit. Besides a printers' mistake there is no mention of the date of the publication.

7. We look forward to the publication of the Urdu translation.

J. P.

LAND MANAGEMENT IN THE PUNJAB FOOTHILLS

BY R. MACLAGAN GORRIE, D.SC.

Punjab Government Press, Lahore, September, 1941. Pp. 68 and xii with 16 illustrations and 7 diagrams. Price Re. 1-6-0.

In the words of the author in his introduction the object of this book is to place in the hands of all who may be concerned with the administration of land a concise statement of the true aims of land management in language which can be understood by those who have not had a scientific training in agriculture or kindred subjects. He has also summarised the main objectives in slightly greater detail and has given them as follows:

(*i*) to show how the present immensely serious retrogression in both cultivated and uncultivated land is the direct result of the increase of population, both human and animal, which has taken place under the present administration;

(*ii*) to point out previous mistakes in administration, often shortsightedly liberal concessions allowing either unlimited free grazing, or the destruction of forest to make way for fresh cultivation;

(*iii*) to outline a future policy of land administration which will prevent such errors being repeated; and

(*iv*) to indicate on the basis of practical experience already gained in the Punjab just how this vast problem of soil conservation can best be tackled on a self-help basis, by using the existing framework of the Co-operative organization but depending upon the forest, agricultural and veterinary departments for technical guidance.

Dr. Gorrie describes the various ways in which misuse of land and of the vegetation growing on it has caused erosion loss of fertility and a dangerous reduction of the water supply. He details many ways in which improvements can be effected and he describes shortly what he considers the most suitable organization for effecting these improvements. The great importance of this subject is rapidly becoming more generally realized, but very little has been written and published about it in India and still less has been done to tackle the problem at all seriously. The Punjab have probably done more than any other Province by their work in the Hoshiarpur Siwaliks and elsewhere and the recent formation of the Anti-Erosion Circle of the Forest Department, and Dr. Gorrie is to be congratulated on producing this most useful book, which gives an excellent general picture of the situation and what he considers should be done to meet it. It is not, of course, to be expected that a book of only 68 pages can give many details of the various anti erosion and other works mentioned, but there will be many readers who would like to know more, for instance, about the construction of silt pits and contour platform (paragraphs 7.9 and 7.10); in fact it is not at all clear what a contour platforms is. It would also be interesting to know more about contour ridging and trenching (paragraph 8.14), *e.g.* the spacing between trenches found most suitable.

At the end of chapter IV appears the following paragraph, which I quote in full, as it explains clearly why it is so difficult to organize any satisfactory system for proper land management:

"One great disadvantage of the present organization of Government is that it is nobody's duty to look after land development as a whole. Various departments have their own limited sphere of land work, *e.g.* the Agriculture Department looks after crop improvement and the prevention of pests, the Veterinary Department

> looks after the health of livestock, the Forest Department looks after demarcated forests, and the Revenue Department collects the land revenue from cultivation. Nobody however is responsible for seeing that each bit of land is put to reasonable and permanent use on the basis of the greatest good for the greatest number, and until some such body is constituted and given some executive authority, there is little hope of this being done."

In chapter X the author outlines the organization which he considers most suitable for carrying out the necessary works of land improvement. I will not describe this in detail, but merely state that an organization such as that proposed would be a great step forward, though apparently it would tend to perpetuate to some extent the existing situation, as responsibility would be divided and no one department would have complete control of the work. It seems to me that what is really wanted is a completely separate and new department of Government, which would be entirely responsible for the whole organization; the administrative and executive officers should have technical knowedge of forestry, agriculture, irrigation, etc., and would work in close co-operation with the district authorities. But whatever form the organization takes, the sooner every province sets up some sort of organization for this most important work, the better.

I have little but praise for this book, but I have a few minor criticisms to make.

(1) It is a pity the printing of the letter press and the photograhs is not better. There are many spelling mistakes, most of which are probably printers' errors, and some of the photographs, which would be excellent if well reproduced, are so blurred and indistinct as to be practically valueless.

(2) Numerous Hindustani words are used. These are mostly explained somewhere or other in the book, but many are used several times without further explanation, and a few are not explained at all. It would have been a great help for those readers (and there will be many), who are not familiar with the meaning of these words, if a glossary had been included.

(3) Some of the cross references to paragraphs and chapters appear to be wrong. For instance, at the end of paragraph 2.3 the reference to paragraph 7.2, etc., seems wrong, and in paragraphs 2.9 and 4.8 chapters VI and VIII should apparently be chapters VIII and X, respectively.

(4) In figure 2 between pages 12 and 13 it would have been useful to have explained what is indicated by the letters A, B and C.

(5) The notes on the rotational grazing schemes depicted in figures 6 and 7 in paragraph 8.8 are difficult to understand. The scheme for a 3-year rotation (Figure 6) is stated to ensure for each block a 16-month rest after the monsoon closure, but the 16 months' closure is shown as coming after the period when the block is open to grazing in the monsoon. Again, for the scheme depicted in figure 7, it is stated that a block grazed in the autumn (by which is apparently meant the rains) for the first two years will have the seedling crop of these two years well established by mid-summer in the third year, when it is grazed again; but the grass in an area grazed in the rains will surely produce no seed, as the cattle will not give the grass a chance even to flower.

But small defects and inconsistencies, such as mentioned above, do not detract from the real value of this most useful book, which, as a more or less pioneer effort on this subject in India, is most creditable to the author, and I consider that all Government officials in all parts of India should read it, as it will help them to realize what an urgent problem proper land management has become and how important it is that it should be tackled without delay in all parts of India.

D. D.

Artificial regeneration has been undertaken on new formed land and low-lying areas in older forest.—*Jagdamba Prasad.*

TROTTER, H.—*Common commercial timbers of India and their uses (Revised edition): i—iv + 234, 1 + 1 — X, 1941.*— The first edition of this booklet was published in 1929. It describes in detail about 130 common Indian woods, giving their scientific, trade and vernacular names, weights, seasoning and strength properties, working qualities, durability, uses, sources of supply, and prices of those timbers.

There is a most useful chapter of 34 pages on the best woods to use for different purposes.

Also there are chapters written in popular languages on log storage, air seasoning, kiln-seasoning and wood preservation.

Appendix I, gives the comparative strengths of Indian timbers as percentages of the strength of teak, and Appendix II is an index of scientific and vernacular names of the timbers described in the book.—*Author.*

EXTRACTS

PRICKLY-PEAR PROBLEM IN AUSTRALIA

By Dr. A. D. Imms, F.R.S.

The entry of the prickly-pear into Australia dates from about 1787, when the species *Opuntia monacantha* was introduced from Rio de Janeiro. The object was to establish the cochineal industry in that land since prickly-pears constitute the host for this particular kind of insect. Some twenty-five other species of *Opuntia* have found their way into Australia, but their origins cannot be traced. All have become naturalized either as serious pests, minor pests or as garden escapes. The two major pest species in Australia are *Opuntia inermis* and *O. stricta*. At one time landowners grew hedges of pricky-pear around their homesteads until they got out of hand and then the hedges were cut down. The rapidity with which these pests have increased is one of the botanical wonders of the world. Their original home is the coastal sector of Texas and Florida where the mean rainfall is 40—50 in. Yet in Australia the plants have adapted themselves to a very different environment and

with a precipitation of only 20—30 in. annually. In 1900 an area of about 10,000,000 acres was affected in Queensland and New South Wales. The invasion advanced with such celerity that at the peak, in 1925, the affected area must have been greater than 60,000,000 acres: in some years the annual increase in infested territory exceeded 2,500,000 acres. The main distribution takes place by seeds, but every broken-off segment of the plant is liable to take root.

The problem of the control and eradication of the pest has been a matter of cost. The great bulk of the infested territory, stretching 900 miles between lat. 20° S. at Mackay, Queensland, to lat. 33° S. at Newcastle, N.S.W., is natural grazing land generally worth less than £1 per acre. Biological control of prickly-pear was first advocated in Australia in 1899. In 1912 the Queensland Government appointed a Travelling Commission to investigate possibilities of biological control in view of the increasing difficulties facing mechanical and chemical methods of eradication. The Commission comprised Dr. T. Harvey Johnston, professor of biology at the University of Queensland, and Mr. Henry Tryon, Government Entomologist to the State. They visited many countries where prickly-pear were indigenous or had become acclimatized and made valuable recommendations for the introduction of insects and diseases affecting *Cactaceæ*. During these travels small stocks of the cochineals, *Dactylopius ceylonicus* and *D. greenii*, were forwarded to Australia. The first named was liberated in the field and in a few years it almost completely eradicated *Opuntia monacantha* and this achievement gave a stimulus to efforts in biological control.

In 1920 the Commonwealth Prickly-Pear Board came into being with Prof. T. Harvey Johnston as scientific controller. It was established to investigate the whole question of the biological control of prickly-pear, being supported by the Commonwealth Advisory Council of Science and Industry and by the Governments of Queensland and New South Wales. Mr. Alan P. Dodd's report* is an official record of the campaign and its progress from the Board's inception in 1920 up to the year 1940. The Board, it may be added, has

* **The Biological Campaign against Prickly-Pear.** By Alan P. Dodd. Published under the authority of the Commonwealth Prickly-Pear Board, Pp. iv+177+37 plates, (Brisbane ; Government Printer, 1940.)

been an independent body from its start, exercising complete control over its investigations, finances and staff. During the nineteen-year period, June 1920 to May 1939, the sums actually spent on prickly-pear control amounted approximately to £168,600.

The operations of the Board were governed by the fact that in America insects, diseases and other agencies keep the prickly-pear within reasonable bounds, whereas in Australia much natural controlling agencies are wanting and there is little check on the spread and reproduction of the pest. The Prickly-Pear Board was concerned with an attempt to bring about a condition of biological equilibrium by the introduction of insects and diseases likely to provide natural checks. The control aimed at depended upon the introduction of a complex or organisms working collectively in destructive unison. Officers of the Board studied insects affecting *Opuntia* in many lands, covering widespread areas of cactus growth in North America, South America and the West Indies. In work of this character it is important to study on the spot, not only those insects actually attacking prickly-pear, but also the natural parasites and predators affecting them. The exclusion of such restraining agents from Australia, if their hosts are to multiply freely and vigorously attack the prickly-pear in the new surroundings, is of prime importance.

The Board established a station at Urvalde, Texas, where extensive preliminary biological work has been carried out and the most promising cactus-feeding insects bred under caged conditions. Also, such insects were tested by starvation and other means regarding the possibilities of their attacking cultivated plants of economic value. The selected species received from America were shipped to quarantine buildings at Sherwood, near Brisbane. Here they were again bred through one or more generations in order to preclude the escape of any parasites that might have been accidentally introduced at the same time. Also, additional tests were undertaken in order further to explore any possibility that the introduced insects might attack crops or other useful plants and not confine their activities to prickly-pear. From Sherwood, species that were deemed promising and that had withstood the foregoing testing, were eventually forwarded to acclimatizing and breeding

centres where the first liberations into the open country were usually carried out.

In all, twelve species of prickly-pear insects were introduced and established in Australia. On the other hand, 150 species of cactus-feeding insects were discovered in America, and of these about 50 species were imported into Australia. It will be noted that the greater number were rejected for various reasons. Many were confined to cacti other than *Opuntia;* others caused too little damage to be of potential value, while some forms were discarded because they did not pass the stringent tests as regards their feeding propensities. Lastly, the unexpected and overwhelming success attending the introduction of a single species of insect rendered further importations of other kinds superfluous.

Of the various species that have become acclimatized to Australian conditions the moth *Cactoblastis cactorum,* the larvæ of which tunnel through the tissues, is the most important. The cochineal became distributed almost everywhere in the prickly-pear country and the plant-sucking bug, *Chelinidea tubulata,* spread in countless millions over various localities. The red spider, *Tetranychus opuntiœ,* said to be only a biological race of the European *T. telarius,* also spread over many thousands of square miles. In his 1929 report Dodd stated that the established complex of insect enemies was already bringing about a considerable degree of prickly-pear control. In the heart of the infested country it was possible to travel for 100 miles without seeing any healthy plants. Thus it would appear that the original conception of a biological association of different enemies working in unison was well justified. It was quite unforeseen, and could not have been foreseen, that the outstanding success in the repression of prickly-pear achieved up to 1936 would have resulted from the activities of a single species of insect. The agent in question is the Phycitid moth, *Cactoblastis cactorum,* from South America. This fact is all the more remarkable because only one small consignment of material was introduced into Australia. It took the form of about 2,750 eggs obtained in the Argentine in March 1935 and a year later, two generations of this insect had been reared in captivity, the original number multiplying to 2,540,000. Between 1928 and 1930 about three thousand million eggs, laid by the descendants of insects from the original

batch, were distributed in the prickly-pear areas. The orange-red larvæ are gregarious internal feeders, which tunnel in companies through the tissues of the plant, thus providing also for the ingress of disease organisms. In this manner the prickly-pear ultimately becomes so completely destroyed that it is reduced to a rotting mass of pulp.

The various other insects that were established have either become suppressed, or their activities nullified, owing to competition with the *Cactoblastis*. It is only locally, and in relation to a few *Opuntia* species of minor importance, that the *Cactoblastis* has shown itself to be ineffective. The most serious of these plants is *Opuntia aurantiaca,* but there is good reason to believe that its control by a species of *Dactylopius* (cochineal), also from the Argentine, seems assured.

The results of the repression programme have led to 22,000,000 acres of former dense pear country in Queensland being selected for settlement. The previous value of this land was almost nothing, but freed from the pest its capital value would average 10s. an acre, without taking into consideration the worth of the new improvements in fencing, water facilities, removal of timber, etc. Hence the State has gained an asset of at least £10,000,000 because of the availability for farming of land hitherto useless. The area once under impenetrable prickly-pears, and now converted to dairy pastures, must exceed 1,000,000 acres on which many hundreds of new settlers live. In New South Wales the greater part of the former prickly-pear country has been brought into production, mainly for sheep grazing, and most of it has been utilized to enlarge adjacent pastoral properties.

The present status of *Cactoblastis* is satisfactory. Concentrated numbers of larvæ are still attacking, reducing and destroying many of the remaining prickly-pear areas of heavier growth. Native parasitic *Hymenoptera* are not exercising an undue amount of control and their importance is not growing. After an interesting discussion of the future of the problem, Mr. Dodd concludes that, up to date, there is no indication that prickly-pear will not continue to be held in complete subjugation by its remarkably efficient lepidopterous enemy.—*Nature,* VOL. 148, No. 3750, September, 13, 1941.

OREGON'S "RED HATS"

BY GEORGE H. SCHROEDER

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The constant and prompt availability of "snap" crews is most important in the use of crew like the Red Hats. The author's description of a co-operative approach to the problem indicates how the 40-men-crew principle may be adapted to varying administrative conditions.

During the summer of 1940 the School of Forestry at the Oregon State College instituted a programme for organization and training of forest fire-suppression crews. Co-sponsors included the National Youth Administration, State Forester, United States Forest Service, Oregon Forest Fire Association, and others vitally interested in the protection of Oregons forest wealth. The objectives of the program were:

1. Furnishing the State of Oregon with an efficient fire organization for call in handling emergency fire situations.
2. Training of forest fire overhead.
3. Furthering the forestry education of participants.
4. Providing deserving students with a means of earning money for school attendance.

Based at a camp on the McDonald State Forest 7 miles from the Forestry School in Corvallis, the crews participated in a unique training program. Two hours of study, two hours of training, and four hours of hard work on approved N. Y. A. projects constituted the day's schedule. Study included a wide range of practical forestry subjects such as first-aid, use of the compass, tree and shrub identification, knot tying, and life saving. Among other things, training consisted of practice construction of fire line, scouting of fires, use of hand tools, and long hard hikes over the rough topography of McDonald Forest. Among the work projects were the following: Road and trail construction, road and trail maintenance, thinning of forest stands, pruning of forest stands, soil-erosion control, white pine blister rust control, and snag felling. During recreation hours some of the men went swimming in the nearby lake, others played games or passed the time by reading the material furnished by

parents and well-wishers. Leave from camp was allowed, but not more than ten per cent. of the camp strength was granted leave at any one time. Those who were fortunate enough to be on leave went skating at the nearby roller rink or enjoyed a show in town.

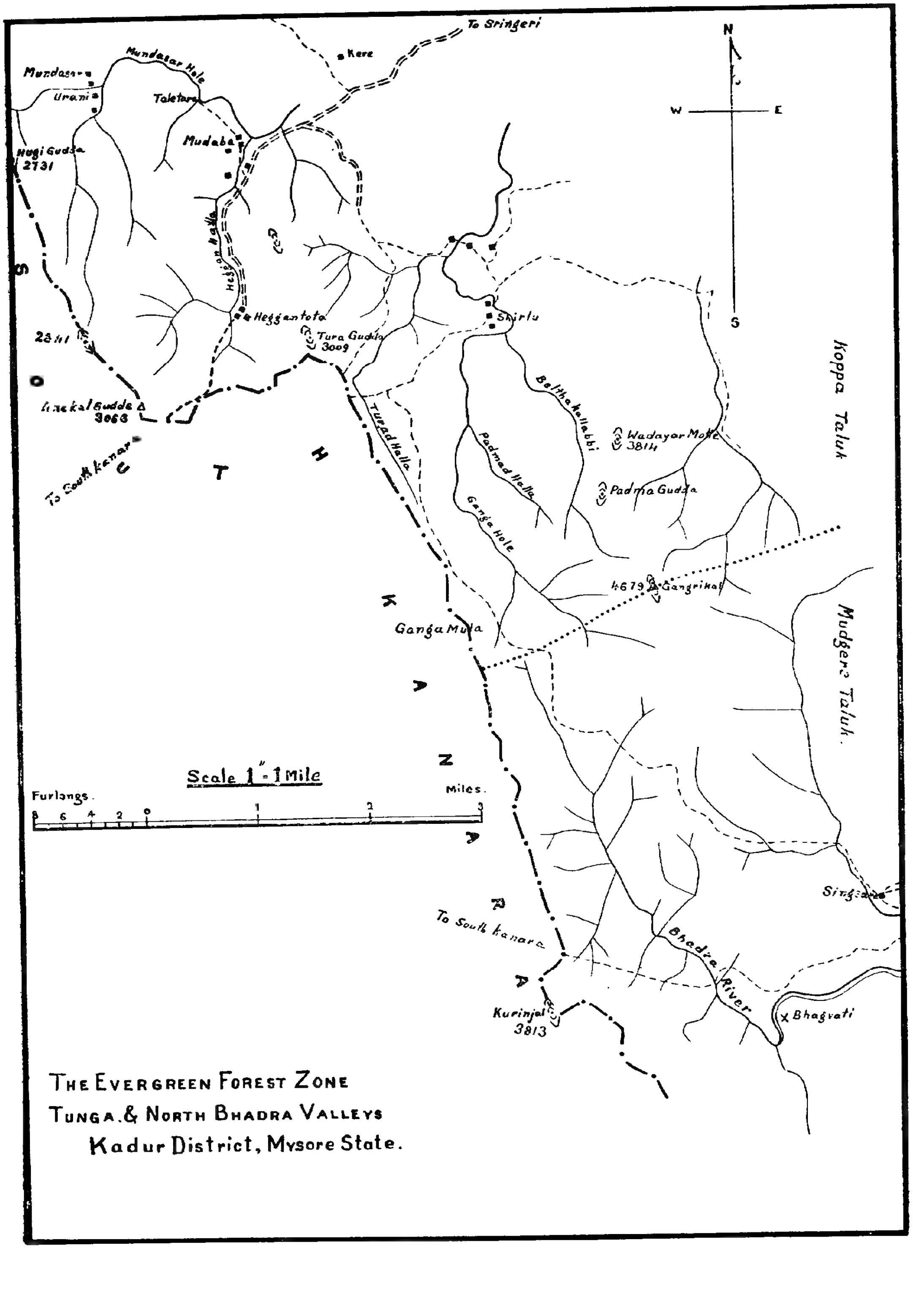
Having advertised themselves as ready to report to a forest fire at a moment's notice, the Red Hats were necessarily very highly organized. The basic unit was a squad of 4 men and a straw boss. One of the straw bosses in each group of ten was the ranking officer, and a foreman was assigned to each crew of 25. Equipped with pick-ups, trucks, and three 25-man busses the camp had ample transportation. Hand tools and mess equipment were packed ready to go at any time. When a fire call came in, the supervisor designated the responsible officer; drivers slipped behind the wheels of the trucks; men who had practised the procedure beforehand slid tool caches into pick-ups; straw bosses checked off their squads; bed rolls were stacked in the rear end of busses and the men loaded in, caulked boots in hand.

On the fire line the crews worked as originally organized or expanded by absorbing civilian fire fighters into their squads. On at least two large fires foremen were detached from their squads and given civilian crews to supervise. Orders were that an assistant be trained for all overhead positions so that supervision would always be available. Since the training program provided time keepers, torch men, truck drivers, cooks, scouts, and other workmen, members of the crews were often used to facilitate the handling of pick-up labor hired for a given fire. Whenever possible, the foreman of the Red Hat crew involved would rebuild his forces from pick-up labor assigned to him. If such substitution was impractical, however, the crew proceeded with control operations as best as it could.

The Red Hat crews were trained in the progressive method of fireline construction. They did not, however, confine themselves to this operation alone, but burned out their line and mopped-up the area after backfiring operations. The men were assigned positions because of aptitude shown in training and practised the duties of those positions in order that the need for supervision in emergency situations might be minimized. While on fire-suppression detail the men were paid a minimum of 40 cents an hour plus their expenses,

the overhead jobs paying more according to their importance. Agreement on the wage scale was reached with the forest-protective agencies in the area before the fire season. The agencies all seemed pleased with the results and their average daily earnings of $ 5.48 also proved satisfactory to the fire fighters. While participating in the base camp training and N.Y.A. work program, the men were only allowed $ 1 per day, but since this amount covered expenses, it did make it possible to train and organize the crews in readiness for fire duty. The resulting total average earning (fire fighting and N.Y.A.) was $ 120 per man above expenses for an average enrolment period of 52.71 days. In addition, 24 men were placed in summer jobs with the forest-protective agencies. The average income per man on these positions was approximately $ 100 a month plus expenses. The program enrolled a total of 113 men. The largest number enrolled at one time was 87. Three 26-man crews were active during the peak of the fire season, and two such crews were available for practically the entire four months (June 1 to October 1).

The camp was initiated for the benefit of first-year students in forestry who were unable to obtain other employment. Because of an abundance of summer jobs last year, all except a small number of the foresters were placed in positions before the fire season opened, and the camp was thrown open, therefore, to any young man in need of employment who was physically fit and wished training in the forestry field. Men were enrolled from almost all of the institutions of higher education in Oregon. College men from at least six other States took part and older high school students proved very good material. Popularity of the training program is indicated by the fact that, although plans for the summer of 1941 are at this time very incomplete, applications are already on hand from several States showing the interest of young men who have heard of the organization but did not take part in 1940. With a strong force of veterans returning and with the probability of a guarantee of minimum earnings in prospect, it would seem that Oregon's Red Hats have proved their value and established the program as a permanent institution.—*Fire Control Notes*, Vol. 5, No. 3, dated July, 1941.



THE EVERGREEN FOREST ZONE
TUNGA & NORTH BHADRA VALLEYS
Kadur District, Mysore State.

INDIAN FORESTER

MAY, 1942

THE EVERGREEN GHAT RAIN-FOREST OF THE TUNGA AND THE BHADRA RIVER SOURCES

KADUR DISTRICT MYSORE STATE—I

BY DR. KADAMBI KRISHNASWAMY,

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General.—The evergreen forest which forms the subject of this note is part of the almost continuous stretch of the evergreen zone covering the crest of the Western Ghats (Sahyadri mountains) all along the mountainous western frontier of Mysore. It includes portions of, hitherto incompletely explored, virgin evergreen forest of the most magnificent type found in the State and embraced by the reserve forests Tungabhadra and Narasimhaparvatha.

The tract dealt with.—This covers the Heggan valley (south-western portion of Narasimhaparvatha State forest), the valleys of the streams Gangehole, Padmadahalla and Belthakallabbi, the semi-tableland forming the undulating ridge between the Tunga and the Bhadra catchment areas and the Bhadra river valley at its source (north-western and central-western portion of Tungabhadra State forest)—*See map in Plate* 15.

The country is generally very hilly, often precipitous. The perennial streams have scoured deep down into their beds forming steep, often nearly vertical, walls standing up to seventy feet high. Small leaps of water locally called *Abbi* are consequently common, the best known ones being Suthinabbi and Belthakallabbi.

Rock and Soil.—The underlying rock contains hornblende schists and banded ferruginous quartzite and iron ores. Chlorite schist is very common in the beds of streams. Granite boulders, both large and small, are abundant at the ground surface and these, intermingled with those of quartz of all sizes, often cover the slopes

of hills and hill tops so thickly that little of the ground surface is available for real soil—the mother of tree growth.

This, in addition to the high wind which often prevails in these localities and the isolation, appears to be responsible for the absence of tree growth from the majority of hill tops and ridges. The forest, therefore, fringes the banks of streams, perennial or otherwise, or covers deep valleys tenanted by leaping streams.

The soil is more shallow than in the Agumbe ghat zone and is further rendered less effective and useful to plant life owing to its pebbly nature. There is relatively little deposit of laterite.

The uppermost soil layers under the evergreen forest cover are as usual rich in vegetable humus.

Rainfall.—The rainfall record kept by the owner of the Heggan Estate, imperfect though it is, indicates that these localities enjoy possibly heavier rain than the Agumbe ghat zone. This is further borne out by the observation that the festoons of the Reindeer Moss-Usnea and the growth of the other musci, bark algae and liverworts in the crowns and on the bodies of the giant trees at the ghat head are relatively more dense and conspicuous. The rainfall recorded here is 350 inches and more.

Humidity.—The air is very humid at all times, especially under evergreen cover. The early morning precipitation of moisture is, even in January, very heavy and amounts to what one would look upon as a miniature rainfall in the mixed-deciduous (moist-deciduous-Champion) zone of forests, indicating that atmospheric water vapour does not swerve far from the saturation point at any time of the day or night. The temperature falls very considerably by night, the cold resembling what one would experience on a chilly November night out in the plains of northern India.

Vegetation: Type of.—This is of the "Moist-Tropical-Evergreen" type. Typically, the top canopy stands a hundred and twenty feet or more high and is normally dense enough to allow only a few rays of sunlight to reach the soil. The forest interior is, therefore, very meagrely illuminated. The underwood and undergrowth are sometimes very abundant, sometimes very meagre, affording in the latter case a clear view and a broad outlook in all directions. Climbers are generally few where the canopy is full, but

appear in large numbers where increasing quantities of light reach the soil.

The Forest: Growth Sub-types.—Though appearing to a casual observer almost homogeneous and uniform, the growing stock exhibits considerable variations of detail. Three, more or less distinct, sub-types of growth are distinguishable, based on the proportion in the crop of the important species whose extraction is engaging the attention of the forest department at present—

Sub-type (1)—The Mixed-Evergreen Type, found in the Heggan valley;

Sub-type (2)—The Semi-Pure Evergreen Type, seen in its typical condition in the valley of the source of the Tunga; and

Sub-type (3)—The Pure-Evergreen Type, found in the valley of the source of the Bhadra.

Sub-type (1)—The Mixed-Evergreen Type

This is found in its typical condition in the Heggan area, which covers the shola drained by the perennial streams Hegganhalla and Mundasarhole.

In this type, *Poeciloneuron indicum* (*balagi*) is the principal species, but this, though numerically the most abundant among individual species, forms yet a small percentage—less than about twenty per cent.—of the growing stock which also includes a large number of other evergreen species forming a dense, intimate mixture. The *balagi* trees of this locality belong to the so-called white variety or *Bile-balagi.*

The species next in prominence to *balagi* is *Palaquium ellipticum* (*hadasale*), but this contributes a small fraction of the growing stock, being numerically far behind the former. A few trees of *Dipterocarpus indicus* (*dhuma*) are present, scattered far and wide, some fine specimens of which may be seen at the foot of Anekalgudde, a ghat-crest peak. *Mesua ferrea* (*nagasampige*) is fairly common, while occasionally, some real huge specimens of *Calophyllum elatum*—the poon (*surahonne*), are found in bunches of four to five trees standing close to one another.

The rest of the evergreen canopy is very rich both in number of species and individuals, as in the Agumbe ghat zone. Noteworthy among the species, a host of which, too numerous to mention, exists, are the following:

Garcinia morella (arisina-guragi), Garcinia cambogia (*kodagolumaruga, Myristica magnifica (ramanadike), Myristica malabarica* (*rampathre*), *Myristica* species (*ramagotu*), *Litsea wightiana* (*doddele-suttanagara*), *Litsea* species (*sanna-suttanagara*), *Ostodes zeylanica* (*nirumara*), *schleichera trijuga* (*kendala*), *Diospyros* species (*doddele-karimarlu, sannele-karimarlu*), *Eugenia* species (*bileminangi, male-nerlu*), *Dysoxylum malabaricum* (white cedar), *Artocarpus integrifolia* (*halasu*), *Artocarpus hirsuta* (*male-halasu*), *Aglaia roxburghiana* (*kemmara*), *Machilus micranta* (*gulmavu*), *Chrysophyllum roxburghii* (*hale*), *Hopea wightiana* (*malehaiga*) **Holigarna** species (*dodele-holegara, sannele-holegara*), *Nephelium longanum* (*sannele-kendala*) and others.

The underwood contains *Canthium* species (*bile-belachi*), *Humboldtia brunonis* (*asage*), *Memecylon* species (*bilehulichappu*) and occasional trees of *Lansium anamalayanum* (*chigatumari*). The undergrowth consists of *Chailletia gelonioides* (*kaduthengu*), *Unona pannosa* (*kadubende*), *Memecylon edule* (*hulichappu*), *Psychotria* species (*vattamadike*) and patches of *Pinanga dicksonii* (*janjarige*).

Edaphic variants on sub-type (*1*).—Fringing the perennial streams in the forest one generally finds *Elaeocarpus tuberculatus* (*sataga*), *Mastixia arborea* (*gulle*), *Gordonia obtusa* (*mallanga*) and *Ficus nervosa* (*kanathi*), the first being most common and the last least so.

Natural regeneration of *balagi* is generally abundant, but of the other species it is inadequate. The seedlings, when present, are struggling for light and would amply benefit by lightening the overhead cover.

Sub-Type (*2*)—*The Semi-Pure Evergreen Type*

This is found in its typical condition at the source of Tunga River, in the valleys drained by the perennial streams Turadahalla, Gangehole, Padmadahole and Belthakallabbi, all of which flow north and unite with one another to form the Tunga. The water-parting ridge between the Tunga and the Bhadra valleys separates this from the source of Bhadra River.

In this type, as in the Mixed-Evergreen type, the principal woods found are *Poeciloneuron indicum* and *Palaquium ellipticum*, but these two alone make up numerically about one half the growing stock and contribute to the bulk of the crop basal area. We find here the typical *Poeciloneuron—Palaquium association.*

Important among the other species, of which relatively few individuals are present, are the following:

Hopea wightiana, *Eugenia* species, *Canthium* species, occasional trees of *Holigarna arnottiana* (*doddele-holegara*), *Aglaia roxburghiana*, *Litsea wightiana* (*doddele-suttanagara*), *Garcinia morella*, *Myristica magnifica*, *Gordonia obtusa* and others.

Conspicuous by their great rarity or total absence are the species *Dipterocarpus indicus*, *Mesua ferrea*, *Dysoxylum malabaricum*, *Elæocarpus tuberculatus*, *Calophyllum elatum*, *Mastixia arborea* and *Lansium anamalayanum*.

The undergrowth of the forest is composed principally of *Unona pannosa*, a species of *Polyalthia*, *Memecylon edule*, *Psychotria* species and patches of *Pinanga dicksonii*. *Strobilanthes* sometimes fills the glades.

Edaphic variants.—Hardly any edaphic variants are distinguishable except in Turadhalla valley, where a few trees of *Elaeocarpus tuberculatus* and *Mastixia arborea* fringe the streams, or occasional trees of *Gordonia obtusa* are present. Otherwise *Poeciloneuron indicum* occupies even the banks of streams. Near Shirlu village—a forest enclosure—a few trees of *Calophyllum wightianum* (*hole-honne*) are present along the Shirluhole.

A good number of hill tops and ridges round about Shirlu village enclosure and elsewhere in this sub-type are bare and grassy, and such localities have been invaded by Bracken Fern—*Pteris aquilina*—and by the palm *Phœnix humilis* (*kireechalu*). The tree growth here consists of *Wendlandia notoniana* (*kan-suragi*) *Careya arborea* (*kowlu*), *Zizyphus* species (*bemmarlu*), and occasional stems of *Butea frondosa* (*muthuga*), *Bucanania latifolia*, *Bridelia retusa* (*bilkumbe*), and miserable looking specimens of *Terminalia chebula*, *Terminalia tomentosa* and *Dalbergia latifolia* (rosewood). This passes on by stages into evergreen forest through the appearance of *Symplocos spicata* (*chunga*), *Olea dioica* (*madle*), *Pithecolobium*

bigeminum (*korachatte*), *Cinnamomum iners* (*kankutla*), *Actinodaphne hookerii* (*galavara*), *Lagerstroemia lanceolata* (*nandhi*), *Artocarpus hirsuta* and others. Occasional well-grown trees of *Albizzia julibrissin (chattumbe)* and *Zanthoxylum rhetza jummanamara*) are found in forest blanks, while in many places the *Oleaceous* shrub *Ligustrum nilgherrense* (*chandraka*) fringes the evergreen forest.

Natural Regeneration.—This, of *balagi,* is very abundant and often covers the ground exclusively by itself; of the other species, including *hadasale,* it is inadequate. Wherever found the regeneration is struggling against paucity of light owing to dense overhead cover.

Distribution of the Age/Girth classes of balagi and Hadasale.—The oldest age classes—mature and overmature—and the youngest ones—seedlings and saplings—are most prominent as regards *balagi,* while the oldest only—mature and overmature—of *hadasale* are present, seedlings and saplings of this species being inadequate or even wanting. The middle girths, precisely those which we require for exploitation, are relatively scarce, and this is a factor which compels the exploring forester to be very conservative in estimating yield from the forest. The above fact also points out that the struggling advance growth of *balagi* would amply benefit by lightening the pressure of the overhead forest cover through exploitation.

Sub-type (3)—The Pure-Evergreen Type

This is seen, in its typical condition, in the valley of the source of Bhadra River, which is made up of a large number of streams, perennial and semi-perennial, running in generally south from the main water-shed line. Standing in this area at a vantage point, as for example on one of the spurs of Gangrikal hill, one can see expanded before him a continuous stretch of wooded country occupying the semi-tableland between the Tunga and the Bhadra valleys and the valley at the source of the Bhadra (Fig. I, Plate 16). In this area the growth of *Pœciloceuron indicum* could be termed truly gregarious, especially so along the banks of perennial streams and on the adjoining lower slopes of the rugged valleys—*Pœciloneuron association.* The species is found almost pure, *Palaquium ellipticum* also being absent, and this is consequently the richest *balagi* tract in Mysore.

Fig. I

Continuous stretch of wooded country occupying the semi-tableland between the Tunga and the Bhadra valleys

Photo: Author

Fig. II

Even the beds of streams are full of *balagi* trees

Photo: Author

Fig. III

Only the oldest and the youngest of these (Age/Girth Classes) are conspicuous

Photo: Author

In a bird's-eye view of the forest, say from an opposite elevated point, the canopy presents a monotonous dark green colour in which hardly any other shade is distinguishable. This forest thus strikes a contrast to the evergreen forest of Agumbe ghat area in which every shade of green and often, in the flowering season, variegated colours are noticeable. In this dark green tapestry the dome-shaped crowns of thousands of *balagi* trees which almost exclusively fill the crown space are distinguishable.

The composition of the growing stock here also presents a contrast to that of the evergreen forest in the Agumbe zone. Like it, the number of individuals is large, but unlike it *the number of species is astonishingly small,* especially so for an evergreen forest which is generally reputed for its richness of species. In other words we have, here, relatively the purest patch of evergreen forest in the State.

Conspicuously scarce or even absent are the species *Palaquium ellipticum* (the chief associate of *balagi* in the semi-pure evergreen type) *Mesua ferrea, Dipterocarpus indicus, Hopea parviflora, Artocarpushirsuta, Aglaia roxburghiana, Schleichera trijuga* and *Lansium anamalayanum.* Even the beds of streams are full of *balagi* trees and species like *Elæocarpus tuberculatus, Mastixia arborea, Lophopetalum wightianum, Gordonia obtusa,* etc., which claim such localities in the Mixed-evergreen type are here almost entirely absent (Fig. II, Plate 16).

More surprising is the fact that the forest floor is covered by myriads of *balagi* seedlings and saplings to the exclusion of nearly all other undergrowth, which is usually very abundant in an evergreen forest. Even patches of *Pinanga dicksonii* are rarely, if ever, seen.

Associated with *balagi* are very occasional trees of *Myristica magnifica, Garcinia morella, Canthium* species, *Nephelium longanum* and *Hopea wightiana.*

Distribution of the Age/Girth classes

Only the oldest and the youngest (Fig. III, Plate 16) of these are conspicuous and here, as elsewhere, trees of the very girths useful for exploitation are relatively few. The *balagi* trees of this subtype also belong entirely to the so-called 'black variety', with relatively short, branchy boles.

Towards Gangrikal hill, *i.e.* as one proceeds east from the head of the ghat, the evergreen forest passes on abruptly into blank, grassy hilltops through narrow belts of dwarf, evergreen growth in which *Symplocos spicata, Olea diocia, Gordonia obtusa, Pithecolobium bigeminum* and *Eugenia corymbosa* (*kunnerlu*) are found. This dwarf growth often ends in *Strobilanthes* or *Ligustrum* bushes, which in turn pass on first into growth of the Bracken (*Pteris aquilina*) and then into grass.

Flowering and Fruiting.—Although the height of the flowering season for the ghat forests dealt with here is in January, when also this exploration was done, very few trees flowered in the area this year. Among those seen in flower at the time were *Elæocarpus tuberculatus, Gordonia obtusa; Symplocos spicata, Eugenia laeta* (*kadupannerle*) and *Humboldtia brunonis* (*asage*). *Canarium strictus* (*kaidhupa*)—the black *damman* tree—was in fruit at the time of exploration.

(*To be continued.*)

AN ATTEMPT ON QUICK GERMINATION OF *TECTONA GRANDIS* SEEDS

By K. K. Bannerjfe,

Forest Ranger

Introduction.—This note introduces no new thing (for there is nothing unknown), but it does claim to provide something new in the matter of adoption of a method as to how germination of local teak seeds may be achieved earlier in these days of economy at a lesser cost and greater percentage of seedlings, to establish a plantation.

Past history and cause for its adoption.—In our miscellaneous forests of Betla, Palaman, in which the exploitation of produce of coppice fellings from one end and selection fellings from the other had been going on, it has been evident that each cycle of felling (coppice with standards and selection) was likely to produce a smaller outturn of commercial timber than in the previous one, even with continuous felling on a long cycle. Young trees of

valuable species are generally few in numbers and sapling regeneration often rare or absent. The position was taken into consideration and various methods and experiments were started. Finally, the *resolution* on the point stressing the need of starting a teak plantation was passed in 1929. Since then, there was an attempt to raise teak plantations and with this object in view the then D.F.O., Mr. M. L. Sen Gupta, I.F.S., collected some good seeds of teak from the Puri Division.

The writer was then instructed to put them into a nursery with proper care. At this time some local seeds were collected by the writer and were treated under certain new methods of his own in order to see their germination as the local seeds were found to have hard testa and were smaller in size.

Process.—As per instructions given by the then D.F.O.. the seeds were soaked for 48 hours in a pond enclosed in a bag and then sown in prepared sunken nursery beds at a spacing of 1 to 2 inches in drills in parallel lines. After 4 weeks 80 per cent. germination was noticed.

These seedlings were transplanted in the month of August to the forests where pits had already been dug at a spacing of 6 ft. × 6 ft. after having been cleared of debris as well as burnt over before the commencement of the rains. The seedlings were weeded twice in order to keep them free from any other neighbouring growth. But for reasons not known the growth of the seedlings suffered badly, and by December, 6 per cent. of the seedlings died.

At this stage Mr. J. W. Nicholson, I.F.S., came as D.F.O. to the Division and passed orders to carry out the work with more care with local seeds and encouraged the writer to push on with his new method of treatment as described at the end of this article and which was thought worth trying.

In 1931, seeds were collected from the trees available in the locality, and the following different methods were adopted for their treatment:

(1) A well-prepared sunken nursery bed having shades on all sides.

(2) A well-prepared sunken nursery bed having shade on the top and the sides open.

(3) A well-prepared sunken nursery bed having shades on the sides and top open.

(4) A well-prepared sunken bed open on all sides and on the top.

(5) Writer's own method.

In methods (1) to (4) all beds were watered from morning till evening from 1st April to the commencement of rains. The result of this method was not conclusive as most of the seeds began to germinate very late in the month of July, 1931.

The germination in case of the writer's method was noticed within three weeks and the percentage was over 55.

In 1932, three methods were adopted as follows:

(1) Soaking the seeds in a tank and raking them with the idea of drying and wetting the seeds alternately to soften the hard testa in order to get early germination.

(2) To keep the seeds near an ant-hill to get the outer coat eaten away by white ants.

(3) Writer's own method.

The result of method No. 1 was not very satisfactory as the germination was noticed only after four weeks which was complete in about two weeks more with a percentage of 30, and this seemed to be low in comparison with the results in other methods.

Method No. 2 was a failure and the 3rd gave a satisfactory result within three weeks, but the germination continued for two weeks thereafter with 60 per cent. of seedlings. This is accounted for by a bad seed year, else more germination could have been obtained. The D.F.O. was very pleased on close examination of the nursery work, to find the high percentage of germination of seeds in the new method, and said that the result had been decidedly better in his opinion. He held this method to be very particularly suitable for that district with local seeds which have not got a very hard testa and are smaller in size than those from other districts.

In 1933, several other methods were continued as per instructions given by the D.F.O.

(*a*) The Forest Research Institute, Dehra Dun, method.

(*b*) Roasting method.

(*c*) Soaking the seeds in a tank and raking them with the idea of alternate drying and soaking.

(*d*) Seasoning seeds on a brick platform and raking them until rain sets in.

(*e*) Writer's new method.

The Forest Research Institute method was started from 1st April in advance and carried out as per instructions laid down in the article on the subject published in the *Indian Forester*. The percentage of germination was low in June, but high and vigorous in July.

The roasting method proved successful. The soaking and raking method gave good results in the part of July when heavy showers commenced. Later, seasoning seeds also gave 20 per cent. of germination but the last method commenced its germination within three weeks and lasted for two weeks when a complete 70 per cent. was noticed. This was inspected by the D.F.O., and the adoption of this method was approved in addition to the method of soaking and raking with some modification.

In 1934, both the above methods were continued with one year old seeds as well as new seeds of the year. It is learnt that old seeds germinated within two weeks and the new seeds within three weeks as per method adopted by the writer and the percentage of germination was over 50 in both cases. The treatment of seeds was started on the 19th April, 1934, and the germination noticed on the 4th and 9th May, 1934.

The process of the writer is very simple and cheap. It saves time in getting a large percentage of germination of teak seeds of Palamau, which are small in size and have a very hard bony nut overcoat which is difficult to split in the ordinary way, except by setting fire to the forests.

Process.—Well-ripened seeds are collected from well-grown mature trees by means of beating the inflorescence noticed to be in a healthy condition. Before beating the inflorescence, the ground is swept over in order to remove all leaves, other materials in a decomposed condition and every sort of insects, beetles and worms, in order to collect only the beaten seeds.

When the seeds are collected, these are carefully examined in order to remove bad seeds, such as squeezed, insect-bitten, half-green, irregular-sized, etc., and the balance is thoroughly dried in

sun on a bamboo *chatai* (matting) for a week, and then packed in dry clean bags. These bags are kept in an open veranda, free from smoke, damp and heat. The collection is done from the middle of February to the first week of March and thus storage is completed.

By the middle of April each year one of these bags is taken out and seeds are inspected in order to throw out any bad seeds such as those attacked by insect. Then the healthy seeds are soaked in water in a pond for 36 hours. After that the bag is taken out and seeds are spread on bamboo mats for 12 hours. The seeds are kept watered and precaution is taken that each seed is spread apart for proper drying. The seeds are to be raked over after 2 to 3 hours in order to see that all are properly drying. No seed should, of course, be allowed to fall on the ground as it may get dirty and an early germination may be affected. In this process a bit of care and attention is required to see that the seeds are properly dried, as otherwise a full success will be doubtful. Sometimes birds or beasts are likely to scatter them as also to otherwise spoil some of them. Such seeds should not be used for soaking again.

This process of soaking and drying is continued for two to three weeks, when most of the seeds show signs of germination and then the process is stopped. But on getting signs of germination in one or two seeds one need not put a stop to the process, but should continue it for a week more when nearly 50 per cent. of the seeds will show signs of germination or will begin to split. At this stage they are to be put into a well-prepared sunken nursery bed. Watering is to be continued till the break of the rains; when rains set in there is no need for any watering. During this process it may be noticed that some seeds will give even more than one seedling.

This process of trial is only an attempt to secure a quick and abundant germination of local teak seeds of the current year available in the district of Palamau and, on close examination, it will be found that this process will result in a decidedly better germination of seeds with hard testa in any other locality as well.

HOW TO COLLECT PHENOLOGICAL RECORDS FOR SHRUBS AND ORNAMENTAL TREES

By K. P. Sagreiya, I.F.S.

Besides climatological data and cultural hints, the most important information that gardeners and arboriculturists require about shrubs and trees is what is technically called phenology, namely a time-table of the vegetative activity of the plants, especially the periods of leaf-shedding, flowering and fruiting.

I describe below a simple method, which I have found quite satisfactory, for the information of those who are interested in keeping such records. A list of species should be maintained in the following form, providing three lines for each species to record the condition of (*i*) Leaves, (*ii*) Flowers, and (*iii*) Seeds (or fruit) from month to month:

Name of species & location	MONTHS.*												Remarks
	January	February	March	April	May	June	July	August	September	October	November	December	
***Delonix regia*, (Gulmohur)**													
Leaves ..	L	L	f	x	x	x	l	L	L	L	L	L	**Flowers bright orange**
Flowers..	x	x	x	x	f	F	F	f′	x	x	x	x	
Seed ..	s	S	S	S	x	x	x	s	s	s	s	s	

***If necessary sub-divide the month into periods of 15 or 10 days.**

The following symbols should then be used for recording the phenological conditions:

Leaves:—Young foliage appearing—

Either the letter l or a small leaf pointing upwards: for vernal tinge, underline l or shade the leaf symbol and write under it the exact shade.

Full foliage on—

Either the letter L or a large leaf pointing upwards.

Leaf-fall in progress—

Either the letter f or a leaf pointing downwards: for autumnal tinge underline f or shade the leaf symbol, and write under it the exact shade.

No leaves—

The letter x.

Flowers.—Flowerbuds appearing—

Either the letter b or a small bud.

Flowers beginning to open—

Either the letter f or a small asterisk.

Maximum flowering—

Either the letter F or a large asterisk and under it the exact shade.

Few flowers on—

The letter f.

No flowers—

The letter x.

Seeds.—Seed formed—

The letter s.

Seed ripe for collection—

S.

No seed or fruit on the tree—

The letter x.

Such records for two or three seasons should give a fairly complete phenology of the plant for the particular locality.

PROPAGATION OF *SAUSSUREA LAPPA (KUTH)* IN GARHWAL UNITED PROVINCES

BY HARI KRISHAN MADHWAL,

Range Officer, Pindar Range

Introduction.—Saussurea lappa Clarke, locally called *kuth,* is "a valuable economic plant of which the useful portion is the root. The root is sometimes known as *pachak.* It is supposed to be the *costus* of the ancients and is often referred to under the name of *costus root.* One of its synonyms is *Aucklandia costus.*"

It is a tall herbaceous plant growing up to 8 ft. in height with large radical leaves up to 5 ft. in length. It is indigenous to Kashmir and Hazara. It has also been introduced in Chamba and Tehri Garhwal States.

Locality.—"*Kuth* cultivation in Garhwal started with half an ounce of seed in 1931, half of which was sown in Bhuna *kharak* (10,500 ft. elevation) and the other half in Bistola bugial (11,500 ft. elevation) in Pindar Range." The areas taken up for propagation of *kuth* in subsequent years are all situated in the vicinity of these two places. The following areas have been planted up with *kuth* up to date:

Bajmora	..	(10,500 ft. elevation)	..	19	acres.
Bhanela	..	(10,000 ft. ")	..	7	"
Bhuna	..	(10,500 ft. ")	..	7	"
Danperi	..	(10,200 ft. ")	..	6	"
Nimdara	..	(10,200 ft. ")	..	6	"
Palwara	..	(11,500 ft. ")	..	8	"
		Total	..	53	acres.

As Bistola appears to be an unsuitable locality, mainly on account of its height, it has since been abandoned. The altitudinal zone for growing *kuth* in Garhwal appears to lie between 9,000 ft. and 11,000 ft. It has been decided to plant up a total area of 60 acres for the present, thus providing 6 annual coupes of 10 acres each, which will be harvested in rotation.

Past history of work.—Initially (in 1931) seeds were sown 4 inches apart in the nursery beds at both Bhuna and Bistola, the object at the time being to produce more seed. There was no new work in the years 1932 and 1933 due to lack of seed. More sowings were done in nurseries over about half an acre at Bhuna in 1934, when some local mature seed became available. By the year 1935 an adequate supply of local seed had been assured and consequently various methods of propagation, *viz.* pit and patch sowings, collar and root cuttings, transplants in nurseries and also in the forest, were tried. In order to determine the effect of shade on the *kuth* plants, sowings and transplantings were carried out separately under dense, moderate and open canopies. The work progressed on more or less similar lines during the ensuing two years.

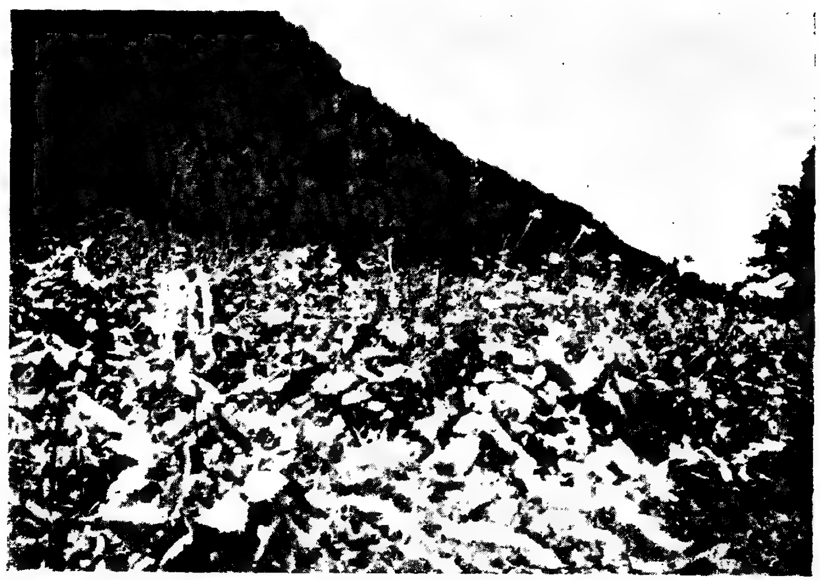
In the year 1938 after detailed observations and a review of the past work, a tentative scheme for growing *kuth* in Garhwal division was drawn up by Mr. D. Stewart, the then Conservator of Forests. According to this scheme forest sowings, being considered less promising in comparison with nursery sowings and transplants, were to be abandoned. An annual coupe of ten acres was prescribed for each year's operations which were to consist either of the "intensive nursery method," *i.e.* nursery propagation in open blanks, preceded by thorough soil preparation with manuring in beds on open flattish ground, or, alternatively, transplanting in pits 15 inches × 15 inches × 15 inches in size; under an open canopy on steeper slopes; or a combination of both methods.

As a result of subsequent experience and developments Mr. Stewart's scheme was revised and amplified by Mr. E. W. Raynor, the present Conservator of Forests, in October, 1940. The main features of this scheme are:

(*a*) The most striking and successful results having been obtained from nursery sowings and nursery transplants in intensively prepared and manured beds in actual *kharak* sites (sheep and goat steadings), the obvious aim should be to exploit this method to the maximum possible extent.

(b) In view of some suspicion among the local inhabitants regarding our taking up established *kharaks* for *kuth* propagation, emphasis was laid on the necessity (pointed out by Mr. Stewart) of ensuring the goodwill of the villagers by providing alternative

Kuth nurseries at Bajmora in 1936
Photo by H. G. Champion



Kuth plantation of 1934 at *Bhuna*, in September, 1939
Photo by H. K. Madhwal

A typical *kuth* root
Photo by E. W. Raynor

kharak sites for them by clear-felling the adjoining forest, whenever an existing *kharak* was taken up. This policy in fact will be advantageous both to the local villagers and to the Forest Department, since the cultivation of *kuth* demands well-manured soil which can only be assured by providing for periodic alteration between steadings of sheep and goats and cultivation of *kuth*. The scheme is now in progress.

Nursery work.—Given a suitable site, kuth is comparatively easy to grow. The seed germinates freely, germination of well-matured seed being more than 75 per cent. in practice. One-year-old nursery plants have been known to produce seed, but viable seed actually appears from the third year. Although no proper seed storage experiments have yet been made, it has been observed that good results can only be assured by using fresh seed, and that seed older than one year loses its viability rapidly. There are about 1,000 seeds per ounce.

Seed is sown in the nursery twice in the year, *viz.* May-June and November. In Garhwal, summer sowings have given better results than autumn sowings, the main reason being damage to the latter by frost-lifting. The plants raised from autumn sowings get a short start, however, of about 1 to 2 months, as the seed remains in a dormant state under snow during the whole winter, but begins to germinate as soon as the snow begins to melt, usually at the end of March. The seed is dibbled in the thoroughly dug and manured nursery beds at an espacement of 4 inches × 4 inches. Germination commences after about ten days in the case of summer (May-June) sowings. Regular weedings are essential, otherwise the rank alpine weeds rapidly swamp the nursery seedlings of *Kuth*.

Transplanting.—Nursery seedlings are ready for transplanting about 12 to 15 months after sowing. Plants of lower age, *e.g.* of 4 to 6 months, have been transplanted in the past, but the results almost invariably have been poor. The stronger the transplants, the better the survival percentage and the subsequent height growth (*vide* Plate 17).

Transplants are technically stumps consisting of 6 inches to 15 inches of root and about 1 inch to 1½ inches of shoot, other parts of the plant being neatly pruned off. The planting technique is

the same as for any other stump planting. To call them transplants is therefore really a misnomer.

Collar and root cuttings of *kuth* have also been tried on a small scale in 1935, and the highest integral yield was obtained from them in 1940 (*vide Appendix III a*). So each year about an acre or so is being planted up with collar cuttings along with ordinary transplants or stumps, and if further confirmation is obtained, this method will be extended.

From the beginning of May (when the *kuth* propagation season actually opens) up to the end of June, either an open *kharak* or a clear-felled adjoining area of forest previously selected for the purpose, is prepared for planting. On flatter portions of the plot the soil is thoroughly dug to 1½ ft. in depth, worked and manured, while on steeper slopes, pits 15 inches × 15 inches × 15 inches in size at an espacement of 3 ft. × 3 ft. are made. The present system is to do about two acres by the former, *i.e.* intensive soil working method, and 8 acres by the latter, *i.e.* pit planting method. The planting espacement of 3 ft. × 3 ft., adopted in both methods, means that about 50,000 plants have to be put out each year. Planting is started in early July and is generally completed by the middle of August. The transplants commence to sprout within a week of planting. As in Kashmir it has been observed that the organism of a *kuth* plant is very characteristic in that it does not seem to forget its age. Thus the plants which have had their full flush of leaves or full growth for the year in the nursery before transplanting, will not usually grow immediately on being transplanted, and remain dormant till the following growing season when they start growing with others. The shoots of *kuth* die back each winter and recommence growing when the winter snow melts in the following spring.

Some local factors.—Kuth thrives best in a deep clayey loam soil with plenty of manure and in moist localities. *Kharaks, i.e.* steadings of sheep and goats, at an elevation of 9,000 ft. to 11,500 ft. usually offer these optimum conditions and are the most suitable sites for propagation of *kuth*. *Kharaks* are sometimes open blanks situated within alpine forests or are actually sited in alpine grassland above the tree limit, known as *bugial*. But since the existing

kharaks are small in area and limited in numbers, the aim is to create *kharak* conditions by clear-felling small portions of alpine forest and manuring it, for *kuth* propagation.

The soil under a canopy of birch (*Betula utilis*), is considered very favourable for *kuth* elsewhere, but in Garhwal birch grows mostly on unsuitable rocky and stony formations. On the other hand, an open mixed canopy of *kharsu* oak (*Quercus semicarpifolia*) and silver fir (*Abies webbiana*) has been found quite favourable for *kuth* in Garhwal division. The reasons for this appear *inter alia* to be side-shade and protection from frost. It, therefore, appears desirable to retain a few trees per acre when clear-felling sites for *kuth* cultivation; firstly, to afford protection and side-shade for the *kuth* plants and, secondly, to reduce the danger of soil erosion. In selecting these protective trees the first choice should be birch, the second silver fir and the third *kharsu* oak, which is the order of their lightness of canopy.

Extraction and drying of the kuth roots.—The best time for the extraction of *kuth* roots is the end of October or early November when they are ripe, the moisture content being lower at this time of the year, (*vide* Mr. Sher Singh's note in the *Indian Forester*, September, 1935).[2] But the severity of the extremely cold climate at these altitudes from the latter half of October onwards rules out the possibility of late extraction. Hence in Garhwal we start harvesting *kuth* roots from the beginning of October and the work is generally completed within a fortnight. The roots extracted become partially dried on the spot before the close of the season in early November, after which they have to be transported down to a drying godown at a lower altitude for further drying and subsequent export to the plains.

The roots after being dug out are immediately cut into short lengths of about 2 inches to 4 inches and are cleaned of earth before putting them on shelves for driage. No details are available of actual drying methods followed in Kashmir, and the opinion of the Forest Utilization Officer at the Forest Research Institute, Dehra Dun, was taken and his suggestions were as follows:

"Fit up shelves, one above the other, one foot apart along walls of a room provided with fireplaces or a chimney. The bottom of the shelves should be perforated to facilitate easy circulation of air.

Kuth roots, cut into pieces of 2 inches to 6 inches length, should be spread on the shelves, a single layer in thickness. The fire kept going in the fireplace will heat up the room and the roots will be dried without getting overheated and without being tainted by the smoke.

"Instead of the fireplace where wood may be burnt, a charcoal stove placed in the middle of the room may be used. In that case one outlet near the roof should be provided for the hot moist air to escape."

Financial results and aspect.—The *kuth* plant matures at the age of five to six years, and the current scheme is therefore being worked on a six year rotation. From the year 1931 to 1936 the total expenditure incurred was Rs. 2,103 with no revenue returns since no *kuth* had yet matured.

In the year 1937, 1 maund, $14\frac{3}{4}$ seers of *kuth* roots, value Rs. 94, were obtained from an area of 1/43 acre in Bhuna and Bistola from the sowings of 1931. In 1939, a yield of 23 mds. 22 seers was obtained from an area of $\frac{1}{2}$ acre in Bhuna, which sold for Rs. 1,573.

In the year 1940, *kuth* was harvested over about one acre of area in Bhuna and Bajmora and yielded 55 mds. 25 seers which sold for Rs. 1,502.

The figures for expenditure are not comparable with the above returns and are inevitably larger since the scheme was expanding over the period.

Regarding the financial future of the scheme, the following extract from Mr. Raynor's note of 1940 is of interest:

"The future anticipated yields of *kuth* being not less than 42 mds. (dry) per acre for combined methods of treatment, an annual coupe of ten acres should produce 420 maunds (dry), which at a minimum sale price of Rs. 30 per maund should fetch Rs. 12,600. The latest forecast of costs is Rs. 760 per acre for the full period of five to six years required for maturing one crop and this includes cost of fencing and *khors* (*i.e.* steading pens). This should ensure a profit approximating to Rs. 500 per acre. By working on a six-year rotation, a substantial annual profit of Rs. 5,000 is, therefore, anticipated for an annual coupe of 10 acres, the area envisaged by Mr. Stewart and endorsed by his successor."

Details of expenditure and expected returns obtained on latest experience in 1941 in the propagation of *kuth* in Garhwal division by the two principal methods described above are shewn in Appendices I and II. Due to the prevailing war conditions, the demand for *kuth* has fallen and last year's crop had to be sold at a flat rate of Rs. 27 per maund. It is anticipated, however, that in spite of the lower sale price the new scheme will commence earning substantial profits from 1943, which will be sustained at about Rs. 4,800 per annum from 1945.

Utilisation of Produce.—Kuth is largely exported to China and Japan, which according to the 1935 statistics consume about 4,000 maunds annually. It is used for burning as incense. *Kuth* is also used as an insecticide.

European countries are also believed to consume a considerable quantity of kuth annually, where it is said to be used in the manufacture of expensive perfumes.

In India the root is valued medicinally for purifying the blood and curing rheumatism.

Kuth roots from Garhwal were sent to the Bio-Chemist at the Forest Research Institute, Dehra Dun, for analysis, and he reported that from a five-year-old average root the moisture percentage varied from 15.29 to 17.15 per cent. and the essential oil percentage in an absolutely dry sample from 2.45 to 3.86 per cent. The Kashmir roots shewed an oil content of 2 to 4 per cent. in the majority of cases. Thus the Garhwal roots compare very favourably with those of Kashmir.

General.—The propagation of *kuth* in Garhwal is thus likely to be a very profitable source of income, and will also provide regular employment and wages for the inhabitants of the neighbouring high level villages.

The *kuth* areas, situated as they are at considerable altitudes, have been linked up by a forest-road from Wan village on the Gwaldam-Ramni District Board road. Bhuna, the central focal site, is about 28 miles due north of Gwaldam and 38 miles from Garur (the terminus of the motor-road) and all the plantations lie on the lower spurs of the mighty Trisul and Nandaghunti massifs.

APPENDIX I

Kuth propagation by Intensive Nursery Method

RECURRING COSTS PER ACRE (BASED ON LATEST EXPERIENCE).

		Rs.	a.	p.
1.	Soil working one foot deep	80	0	0
2.	Transplanting. Plants spaced at 3 ft. × 3 ft.	25	0	0
3.	Weedings. Three weedings per annum in the first two years, one in the third and one in the fourth year at Rs. 10 per weeding	80	0	0
4.	Digging up *kuth* roots in the fifth or the sixth year ..	90	0	0
5.	Supervision charges—			
	(*a*) Temporary establishment. Two *malis* over 12 acres, *i.e.* total acreage under this method in one rotation, for eight months at Rs. 15 per month each	20	0	0
	(*b*) Plantation *jamadar* for over 12 acres for eight months at Rs. 27 per month	18	0	0
6.	Air drying *kuth*: half drying 186 mds. of green *kuth* at As. 2 per maund of green *kuth*	23	4	0
7.	Carriage from Bhuna to Gwaldam, 103 mds. of half dry *kuth* at Rs. 2-8-0 per maund	257	8	0
8.	Air drying 103 mds. of half dry *kuth* at Gwaldam at As. 2 per maund	12	14	0
9.	Carriage to Plains market—			
	(*a*) Gwaldam to Garur, 55 mds. of air dry *kuth* at As. 9 per maund	30	15	0
	(*b*) Garur to Haldwani, 55 mds. of air dry *kuth* at Re. 1 per maund	55	0	0
	(*c*) Haldwani to Bareilly, 55 mds. of air dry *kuth* at L.S.	18	2	0
10.	*Bugial* allowance to permanent establishment at Rs. 200 per year on 12 acres	16	10	0
11.	Cost of permanent nursery at Rs. 20 per acre	20	0	0
12.	Cost of *ringal* fencing per acre	5	0	0
13.	Contingencies, making *khor*, cost of manure, bags for *kuth* and tools, etc.	40	0	0
14.	Other unforeseen charges	7	11	0
	Total Rs.	800	0	0

Net yield per acre 55 mds. of air dry *kuth* at Rs. 27 per maund .. .. .. = Rs. 1,485
Net profit per acre .. .. .. = Rs. 685

APPENDIX II

Kuth propagation by transplanting in pits 15 ins × 15 ins. × 15 ins. and spaced at 3 ft. × 3 ft. under open or very open canopy of silver fir, _kharsu_ and birch.

RECURRING COSTS PER ACRE (BASED ON LATEST EXPERIENCE).

		Rs.	a.	p.
1.	Clearing site of under growth and slash disposal ..	20	0	0
2.	Digging pits 15 ins. × 15 ins. × 15 ins. at 3 ft. × 3 ft.; 5,000 pits at Rs. 3 per 100 pits	15	0	0
3.	Transplanting 5,000 plants at Rs. 5 per 100 plants ..	25	0	0
4.	Weedings. Three weedings per year for three years and one weeding in the fourth year at Rs. 10 per weeding	100	0	0
5.	Digging up *kuth* roots in the fifth or the sixth year ..	95	0	0
6.	Supervision charges—			
	(*a*) Temporary establishment. Two *malis* over 48 acres *i.e.* total acreage under this method in one rotation, for eight months at Rs. 15 per month each	5	0	0
	(*b*) Plantation *jamadar* over 48 acres for eight months at Rs. 27 per month	4	8	0
7.	Air drying *kuth* : half drying 140 maunds of green *kuth* at As. 2 per maund of green *kuth*	17	8	0
8.	Carriage from Bhuna to Gwaldam, 80 maunds of half dry *kuth* at Rs. 2-8-0 per maund	200	0	0
9.	Air drying 80 maunds of half dry *kuth* at Gwaldam at As. 2 per maund	10	0	0
10.	Carriage to plains market—			
	(*a*) Gwaldam to Garur, 40 mds. of air dry *kuth* at As. 9 per maund	22	8	0
	(*b*) Garur to Haldwani, 40 mds. of air dry *kuth* at Re. 1 per maund	40	0	0
	(*c*) Haldwani to Bareilly, 40 mds. of air dry *kuth* as As. 0-5-3 per maund	13	2	0
11.	*Bugial* allowance to permanent establishment at Rs. 200 per year on 48 acres	4	3	0
12.	Cost of permanent nursery at Rs. 20 per acre ..	20	0	0
13.	Cost of *ringal* fencing per acre	5	0	0
14.	Contingencies, making *khor*, cost of manure, bags for *kuth* and tools, etc.	40	0	0
15.	Other unforeseen charges	13	3	0
	Total ..	650	0	0

Net yield per acre = 40 mds. of air dry *kuth* at
Rs. 27 per maund = Rs. 1,080

Net profit per acre = **Rs. 430.**

APPENDIX

Some statistics of

(a) Yield

Year	Sowing in nursery beds (Actual *kharak* sites, with plenty of manure)	Sowing in pits and patches (in forest)	Transplanting in nursery beds
(1937)	91 plants=118 seers (green), or about 1½ seers green per plant, or about 6 chtks. (dry) per plant.	..	..
(1939)	1,400 plants=86 mds. (green), or about 2½ seers (green) per plant, or about 11 chtks. (dry) per plant.	..	..
(1940)	1,001 plants=53 mds. 13 seers and 12 chtks. (green), or about 2 seers, 2 chtks. (green) per plant, or about 9 chtks. (dry) per plant.	263 plants=6 mds. 5 seers (green), or about 15 chtks. (green) per plant, or about 4 chtks. (dry) per plant.	416 plants = 28 mds. 14 seers (green), or about 2 seers 11 chtks. (green) per plant, or about 12 chtks. (dry) per plant.
(1941)	342 plants=40 mds. (green), or about 4 seers, 10 chtks. (green) per plant, or about 1 seer, 2½ chtks. (dry) per plant.	1,739 plants=28 mds. 21 seers (green), or about 10½ chtks. (green) per plant, or about 2½ chtks. (dry) per plant.	..

(b) Yield per Acre

(1937) 1,000 s. ft.=54¾ seers of (dry) *kuth*, or about 58 mds. (dry) per acre.

(1939) ½ acre =23½ mds. of (dry) *kuth*, or 47 mds. of (dry) *kuth* per acre.

(1940) 1 acre =55 mds. 25 seers (dry) *kuth*.

(1941) 2 acres =324 mds. of (green) *kuth*.
or 1 acre =162 mds. of (green) *kuth*, or about 48 mds. (anticipated) of dry *kuth*.

III

yield of *kuth* roots

per Plant

Transplanting in pits 12 ins. × 12 ins spaced 3 ft. apart (in forest or in open field)	Collar cuttings	Root cuttings
..	..	..
..	..	..
In forest— 2,952 plants=96 mds. 11 seers (green), or about 1 seer 5 chtks. (green) per plant, or 5¾ chtks. (dry) per plant.	4 plants=32 seers (green), or about 8 seers green per plant, or about 2 seers (dry) per plant.	8 plants=64 seers (green), or about 8 seers (green) per plant, or about 2 seers (dry) per plant.
In open field— 2,200 plants=186 mds. (green) or about 3 seers 6 chtks. (green) per plant, or about 13 chtks. (dry) per plant. *In forest*— 2,390 plants=68½ mds. (green) or about 1 seer 2 chtks. (green) per plant, or about 4½ chtks. (dry) per plant.	11 plants=1 md. 4 seers (green), or about 4 seers (green), per plant, or about 1 seer (dry) per plant.	..

(c) *Driage per cent.*

(1937) 188 seers of green *kuth* roots produced about 54¾ seers of the dried sale product, *i.e.* 1 md. green *kuth*=11 seers dry *kuth*.
∴ Driage=72·5%.

(1939) 86 mds. of green *kuth* roots produced about 23 mds. 22 seers of the dried sale product, *i.e.* 1 md. green *kuth*=11 seers dry *kuth*.
∴ Driage=72·5%.

(1940) 185¾ mds. of green *kuth* roots produced about 55 mds. 25 seers of the dried sale product, *i.e.* 1 md. green *kuth*=about 12 seers dry *kuth*.
∴ Driage=70%.

(1941) Driage (anticipated)=about 70%.

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RAFTING IN THE MYITMAKA EXTRACTION DIVISION

By G. Maung Si, E.A.C. Forests

Government rafting from depots along the Myitmaka River in the Myitmaka Extraction Division to Nyaungwaing in the Depot and Agency Division used to be done by the contractor who tendered the lowest rate for the work as a whole. This necessitated a man with considerable capital, as Rs. 500 had to be deposited as security and Rs. 500 was advanced to each of about 15 raftgaungs who signed agreements with the contractor similar to that signed by him with Government. The contractor took 15 per cent. of the gross payments as profit and shelved all responsibility for carrying out the work successfully onto the raftgaungs, who gave him immovable property against their advances. His only risk was the loss of his security deposit, should there be a complete failure of all rafting. The contractor, whoever he might be, always employed the same raftgaungs and raftsmen from Sanywe and Pogaung villages; they were experienced men and rafts had to stop at their villages *en route*. If not employed, they were likely to terrorise raftsmen from other villages or damage the rafts.

Competition amongst capitalists, the low cost of living and several years favourable to floating, gradually reduced the rates tendered for rafting from the main Myitmaka Depot at Hmetkadan from Rs. 150 per 100 logs in 1929 to Rs. 45 in 1934. This low rate, from which the contractor and raftgaungs had to deduct their profit, left so little for the raftsmen, on whom depends the ultimate success of the work, that they had barely sufficient money left to live on, even whilst carrying out the actual work.

In 1935 the tender system was stopped and the logs for rafting were divided into lots of about 2,000, one lot being given to each of the raftgaungs who had previously worked under the rafting contractor. Each raftgaung now deposits Rs. 100 as security and the rafting rate is fixed at the beginning of the season, after consideration of the cost of living and the prices of rafting materials.

Rates under the new system have risen from Rs. 55 in 1935 to Rs. 90 in 1939 and 1940. Before the 1939 rafting season, political movements and strikes elsewhere influenced the raftgaungs to form a ring and demand Rs. 150 per 100 logs. The ring was broken and the work carried out satisfactorily at Rs. 90 per 100 logs, which was calculated to give 20 per cent. profit to the raftgaungs after making allowance for the cost of materials, interest on any advances they might have to take from money-lenders and a very reasonable rate of payment to the raftsmen.

Logs from the jungle are floated loose or departmentally in rafts to main storage depots along the Myitmaka River, the chief of which are Hmetkadan, with an average stock of 60,000 logs and Athanaw with about 15,000 logs. From Hmetkadan to Nyaungwaing is 100 miles and from Athanaw 55 miles. Rafting along the Myitmaka River is complicated by several channels connecting it with the Irrawaddy River through which Irrawaddy flood water flows to the Myitmaka and raises the water level by as much as 20 feet. Floods at Bhamo or Mawlaik take about 10 days to reach Hmetkadan Depot and should the Irrawaddy and Chindwin Rivers rise at the same time, the water level at Hmetkadan rises so high that rafts cannot be despatched. Another complication is the Shwelaung Bauk between Hmetkadan and Nyaungwaing, as this is the largest connecting channel between the Irrawaddy and Myitmaka Rivers. Water always flows from the Irrawaddy to the Myitmaka River along this channel, but on reaching the Myitmaka sometimes flows upstream towards Hmetkadam. Normally, there are three rises and falls of the Irrawaddy flood water at Hmetkadan of which the second and third falls are usually used for rafting, so that each raftgaung makes 2 trips to fulfil his contract. Rafts ready for despatch have sometimes to be held up for 2 months because the floating levels are too high, and so raftgaungs have to incur extra expense in main-

taining their raftsmen, which is now, however, made up to them by a special clause in their contracts.

Myitmaka Extraction Division rafts are poor looking affairs, as logs are tied together only by *kyakhat* bamboos. The first sections are 25 feet wide and contain 15 logs tied to the bamboos through the *napas* with coir yarn (*na-mathi-kyo*). The 12 or 13 sections in a raft have a total length of 250 feet. From the ninth section to the end of the raft width of the section is gradually reduced so that the last one is only 10 feet wide. In a section the two wings logs (*let-na*) and the centre log (*oo-gyaung*) are the most important and must be of the same length. The two inner wing logs (*let-na-myaung*) are also important and should be slightly shorter than the wing logs. The first three and the last three sections in a raft are the most important and in these sections all logs must be approximately of the same length; any short or unshapely logs are rafted in the middle sections between the wing, inner wing and centre logs.

The wing and the centre logs of each section are joined to each other by 2½-inch coir rope (*kha-set-kyo*) and the inner wings are tied on with canes, except in the first three and last three sections where coir rope is used. The first three sections are kept 4 feet apart so as to be flexible and respond to steering by oars of which there are three, 19 feet long, kept ready in loops attached to a log tied across the front of the first section. All other sections touch each other. The last section is made as strong as possible to carry a jungle wood log about 12 feet by 4 feet, tied on with supporting and presser poles as a mooring block (*that-tone*). The mooring rope, 500 feet long and 5 inches in girth, is tied round the mooring block and gradually eased to stop the raft gently and causes great strain on the block. When the sections are roped together an extra 4 feet is allowed in the connecting rope to tie on long logs which overlap the start of the next section and form buffers (*pan-done*). On each raft a small hut is built and roofed with *thekke*.

Logs are stored at Hmetkadan in compartments containing about 5,000 logs, so that several raftgaungs are needed for each compartment. Should those allotted to a raftgaung include many large ones, which make a raft difficult to steer and reduce the number of logs in a raft, he will go to great lengths to get rid of the

large logs. Most of the raftsmen are opium consumers and the raftgaungs will sometimes give them free opium if they can exchange the big logs for small ones. Logs are exchanged between raftgaungs and also for those in unallotted compartments, which should not be rafted. Experienced raftgaungs usually come off best at the expense of a new raftgaung so that the latter ends up by going to the Timber Assistant in charge with a tale of woe that most of his small logs have changed into large ones.

As soon as the raft has been finished, each log is numbered and hammered with a special rafting hammer and a removal pass is issued. The Timber Assistant then anxiously watches the water level at the depot and the Irrawaddy gauge readings so that he can tell the raftgaungs when they should leave the depot. If he makes a mistake, the raft may be broken up by the strong current from the Shwelaung Bauk, get out of control, run aground or be destroyed by hitting a pier of the railway bridge at Gamonzeik.

When rafts have left the depot they are joined two abreast by 4-inch coir ropes (*pu-kyo*) so that 6 rafts from the depot form 3 rafts for floating, each manned by 7 raftsmen, with the raftgaung on one of them The double raft is separated into the original rafts whenever floating conditions are difficult. Rafts tie up every night *en route* and are usually inspected at Sanywe, near Tharrawaddy, for part payment of the rafting rate. A log that gets astray from a raft has little hope, as villagers all the way down the Myitmaka are short of timber and have become expert at concealing a log for sale later when the hue and cry for missing logs has died down.

In spite of the difficulties of rafting to Nyaungwaing the annual loss of logs is only about 20 out of the 30,000 logs normally sent each year.

TIMBER PRICE LIST, MARCH-APRIL, 1942
(INDIAN STATES)
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Cochin ..	Logs ..	Re. 0-8-0 per c.ft.
,,	,,	Travancore..	Logs ..	Re. 0-11-0 per c.ft.
Benteak ..	*Lagerstrœmia lanceolata*	Cochin ..	Logs ..	Re. 0-8-0 to 1-0-4 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	Rs. 1-3-2 to 1-5-0 per c.ft.
,,	,,	Travancore..	Logs ..	Rs. 1-4-1 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Barwani ..	Logs ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Cochin ..	Logs ..	Rs. 1-3-5 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, .	,, ..	Holkar ..	Beams 14′×18″	Rs. 1-8-0 per c.ft.
,, ..	,, ..	Hyderabad..	Logs ..	Re. 0-8-0 to 1-8-0 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	Re. 0-8-0 to 2-6-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore..	Logs ..	Rs. 1-8-11 per c.ft.
Deodar ..	*Cedrus deodara* ..	Patiala ..	Sleepers 10′×10″×5″	Rs. 7-4-0 each.
Dhupa ..	*Vateria indica* ..	Cochin ..	Logs ..	Re. 0-12-11 per c.ft.
Gamari ..	*Gmelina arborea* ..	Tripura ..	Logs ..	Re. 1-0-0 to 1-12-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Cochin ..	Logs ..	Re. 0-14-9 per c.ft.
,, ..	,, ..	Tripura ..	Logs ..	Re. 0-8-0 to 1-4-0 per c.ft.
Haldu ..	*Adina cordifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Banswara ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	Re. 0-8-0 per c.ft.
,, ..	,, ..	Bhopal ..	Logs ..	
,, ..	,, ..	Cochin ..	Logs ..	
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	Re. 0-12-6 to 1-6-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore..	Logs ..	Re. 0-12-7 per c.ft.
Hopea ..	*Hopea parviflora* ..	Cochin ..	Logs ..	Rs. 1-8-7 per c.ft
,, ..	,, ..	Travancore..	Logs ..	Rs. 1-5-8 per c.ft.
Indian Rosewood..	*Dalbergia latifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	Re. 1-0-0 per c.ft.
,, ..	,, ..	Cochin ..	Logs ..	Rs. 1-1-10 to 3-13-7 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Kishengarh	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	Re. 0-10-6 to 3-6-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore..	Logs ..	Rs. 1-1-3 to 2-3-8 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul ..	*Xylia xylocarpa* ..	Cochin ..	Logs ..	Re. 0-7-5 to 1-8-7 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-2-7 per c.ft.
Kindal ..	*Terminalia paniculata* ..	Cochin ..	Logs ..	Re. 0-11-1 to 1-3-8 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Re. 0-13-6 to 0-14-8 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-1-1 per c.ft.
Laurel ..	*Terminalia tomentosa* ..	Bansda ..	Logs & squares	
" ..	" ..	Barwani ..	Logs ..	Re. 0-10-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Re. 0-14-0 to 1-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Re. 0-8-6 to 1-6-2 per c.ft.
" ..	" ..	Holkar ..	Sawn material	
" ..	" ..	Hyderabad ..	Logs ..	Re. 0-9-0 to 1-8-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Re. 0-10-3 to 1-0-4 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	Rs. 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Cochin ..		
" ..	" ..	Tripura ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
Sal ..	*Shorea robusta* ..	Cooch Behar	Logs & scantlings	Re. 0-12-0 and 1-8-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Tripura ..	Logs ..	Re. 1-0-0 to 1-8-0 per c.ft.
Sandan ..	*Ougeinia dalbergioides* ..	Bansda ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Banswara ..		
" ..	" ..	Cochin ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-4-0 and 0-8-0 per c.ft.
"	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
" ..	" ..	Travancore ..	Logs ..	Re. 0-11-0 per c.ft.
" ..	" ..	Tripura ..	Logs ..	Re. 0-4-0 to 0-6-0 per c.ft.
Sissoo ..	*Dalbergia sissoo* ..	Banswara ..	..	
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-12-0 and 1-8-0 per c.ft.
" ..	" ..	Hyderabad ..	Logs ..	Rs. 1-2-0 to 2-12-0 per c.ft.
" ..	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
Teak ..	*Tectona grandis* ..	Bansda ..	Logs ..	
" ..	" ..	Banswara ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 0-12-0 to 1-8-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Rs. 1-8-0 to 2-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 1-8-7 to 3-7-5 per c.ft.
" ..	" ..	Holkar ..	Sawn material	Rs. 3-8-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Re. 0-12-0 to 3-4-8 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Re. 1-3-3 to 2-12-10 per c.ft.

EXTRACTS

MODERN AERONAUTICAL MATERIALS

Wood and metal are the prime materials contributing to the design of flying machines. Not only in their natural state but in the form of derived products· the results of chemical and other treatments, they both evince their individual advantages and shortcomings for the purpose to which they are applied. It is accordingly somewhat difficult to arrive at a judgment on the respective value and suitable fields of employment of the two materials, as it varies and depends to a great extent on the development of research work and the results obtained in practical performance. The all metal plane appears to be the predominant type, but timber in plane construction, and it must be remembered that when

Flight-Leader Swain of the R.A.F. set up a new height record only a few years ago, it was in a Bristol 138, which with the exception of the engine, the whole plane was of wood. It is considered that wood affords better resistance to the fluctuations of temperature. For war purposes, however, the all-metal type is definitely preferable.

Plywood Possibilities

The lack of uniformity and homogeneity in the structure of wood has to a great extent been overcome by the employment of plywood, and the possibilities are still being actively explored, especially in the direction of new methods of treatment and evolution of synthetic substances, some of which have already proved very satisfactory. The formation of laminated boards of very thin veneers glued together with synthetic plastic cements under pressure has done away with the weaknesses of grain and faulty places in the wood. The result is not merely an increase in strength, but the moisture absorption capacity of the new board is reduced by 80 per cent. after 48 hours' immersion in water in comparison to natural wood. During the last war, timber-built planes were in the overwhelming majority, and even where timber was not exclusively used, the metal formed but an insignificant component. Though post-war development has brought about a change in this respect, it could not be denied that wood has the great advantage of relatively great strength with low specific weight a factor that would seem to pre-destine it for aeronautical construction. Recent success in evolving processes that, whilst conserving all the natural advantages of wood, obviate many of its drawbacks, the discovery of new cements, the urgent necessity of employing to full advantage the indigenous sources of raw material supplies, all have tended to bring timber structural methods back into prominence and have led to the development of new types.

Suitable Material

In proceeding to a choice of the suitable material for aeronautical construction, it is in the first place a question of establishing the relation between breaking strain to specific weight, a figure often taken as a quality factor. In the case of sound, knot-free pine the relation of tensile to compressive strength is about 2 : 1, whereas the coresponding factor for modern light alloys is about

1 : 1, whilst the strength of the latter under tension is about 15 per cent. and under compression 60 per cent. greater than that of pine. It was thus obviously necessary to increase the compressive strength of wood and seek to attain an equalization of the two factors. It might be mentioned that suitably treated beech is superior to the alloys. In view of the short life of a plane the normal destruction of wood by rot, etc., need hardly be considered, and certain signs of disintegration formerly attributed to wood have been shown to be due to faulty glues. The considerable fluctuations of temperature to which a plane is subjected in a comparatively short flight have no ill effect on the wood (low coefficient of expansion) and dimensional variations in the parts due to temperature are thus very slight in wooden planes, a matter of extreme importance in the case of steering rods, etc., any expansion in which lead to insecurity in flight. In the case of seaplanes the resistance to sea water and the fact that wooden floats, even when damaged, afford buoyancy is of considerable advantage.

Moisture Variation

At the same time, it must not be overlooked that wood is extraordinarily subject to variations of moisture and is very apt to "work", *i.e.* warp and buckle; its strength also temporarily depreciates to some extent. This renders necessary special attention to the dimensioning of the parts heavily stressed in the fuselage (boom capping, etc.), but the intrinsic qualities of the wood may be so improved by special treatment that the reaction to moisture may be kept well within control. As may be expected, plywood plays a decisive part in the development of all-timber aeronautical constructional methods, although the requirements that have to be satisfied by the plywood maker are by no means negligible. It is accepted as quite a matter of course to produce 5-ply boards with a thickness of 6 mm., although the usual specifications call for thicknesses ranging from 1 to 1.5 mm. As the demand for lightness is carried to the utmost limit in aeroplane construction, and the strength of the material employed must be used to the extreme extent of its capacity, the manufacture of plywood calls for the utmost technical and mechanical precision. The whole of the wing and fuselage covering may be of plywood complying with the definite physical demands of the case; plywood affords an air-proof and

aerodynamical surface of great efficiency. The shearing stress in the fuselage is taken up by the plywood, and an extremely light type of construction achieved by lattice members, systems of rods with plywood straps, particularly for wing frames and similar parts.

Resin Cements

The cements now used, *i.e.* the water-proof and bacteria resisting synthetic resin type, are favoured. It would seem desirable also to devise methods for connecting metal to wood by means of cement, especially as the use of metal connectors increases the dead weight. Certain of the methods hitherto tried out with synthetic resin plastics have proved quite successful in practice (metal edging of propellers). The employment of synthetic resin cements has rendered it possible to produce beech plywood that is adequate for aeronautical construction specifications. This applies especially to parts subjected to high longitudinal stresses (fuselage, etc.), and at parts where metal and wood adjoin. In the latter case, its high frictional coefficient at holes reduces the number of rivet connection requisite at a joint. The unequal strength present in natural wood sections is avoided by arranging the lamina to correspond with the stresses, which ensures the best possible utilization of the dead weight. Another solution of the problem is to employ plywood of various species of woods, and finally the desired qualities of the product may be attained by certain impregnation of the various layers before glueing together.—*Indian Engineering*, Vol. CX, No. 3, September, 1941.

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THE DESERT EDGE OF INDIAN AGRICULTURE

By W. Burns, C.I.E., D.Sc.

Agricultural Commissioner with the Government of India

In all spheres of human action extreme climatic conditions present problems of scientific interest and practical importance. This paper deals in the main with the problems and potentialities of Agriculture in that large tract of country which divides the Great Plain of the Indus from the Gangetic Plain; in other words, with the dry areas of Rajputana and the adjoining and comparable parts of Sind and the Punjab. The natural vegetation of these areas is

of the typical desert kind, consisting of scattered thorny trees and bushes or succulent plants, and an ephemeral monsoon flora. In Jodhpur State the prevailing tree is *Prosopis spicigera,* locally called *Khejari,* which is a valuable tree fodder. Bushes of *Capparis aphylla* are common, as is the low scrubby ber, *Zizyphus nummilaria; Mimosa nutricaulis* is another common thorny shrub, whilst *Calotropis procera* is found everywhere. There are many useful perennial fodder grasses. In Ajmer-Merwara the *Babul* tree, *Acacia* arabica, is common, and on the denuded hills of this territory one finds masses of *Euphorbia neriifolia.* It is of interest to note that as recently as 1819 Merwara was described in the Gazeteer as "impenetrable jungle'—a striking contrast to its present condition Most of the tract just described lies outside the range of the great irrigation systems of Sind and the Punjab, and there is only very limited scope for supplementing the rainfall by irrigation. Wells are naturally of the highest importance and are worked to full capacity. A variety of waterlifts is employed, including the Persian wheel, the common leather bag or *Charsa* and the *piccottah.* Great skill is shown in the management of small quantities of irrigation water, and it is worthy of note that the crops produced, even in a famine year are those grown for sale, *viz:* cotton, chillies, carrots, onions, garlic and lucerne. The main food and fodder crops are dependent on the scanty rainfall. In a bad year there is considerable mortality amongst cattle, as well as migration to more favoured areas in Central India The transport of baled grass to such areas in years of scarcity is now an established practice, but there are still considerable difficulties in transporting sufficient quantities to Rajputana from the other parts of India. In the main, this great tract produces crops dependent on rainfall alone, of which the *Kharif* (or monsoon) crops harvested in the autumn, are the more important. Here the main difficulties are:—

(1) Delay in the commencement of the monsoon which results in late sowing and consequently reduced yields;

(2) Post-monsoon drought which has a bad effect on the ripening of the crops, particularly such as happen to be late maturing;

(3) Long intermittent dry periods during the growth of the crop which cause cessation of growth and seriously im-

pair the size and yield of the plants. In the production of the un-irrigated rabi or winter crops the characteristic difficulties are—

(i) poor germination due to lack of moisture in the surface soil at the time of sowing;

(ii) Droughty conditions during the whole life of the crop.

"Dry-farming" methods suitable to tracts where the average rainfall is 20 inches per annum need to be modified if they are to be applied to areas characterised by a rainfall of 15 inches or less, and by great heat with dry winds. Dry-farming research was started several years ago in the Bombay Deccan and is now carried out at a chain of experiment stations financed, or subsidised, by the Imperial Council of Agricultural Research. These are at Sholapur and Bijapur in the Bombay Province, Hagari in the Madras Province, Raichur in the Nizam's Dominions and Rohtak in the Punjab. At all these stations except the last the annual average rainfall of the order of 20 inches and the soils are non-alluvial. At Rohtak the average annual rainfall is 16.41 inches and the soil is alluvial. Rohtak is just within the desert area, and is situated in a part of the Punjab which in recent years has been subject to famine on account of failure of rain, particularly in the years 1938 and 1939, in which years the rainfall at Rohtak was 8.24 and 10.20 inches respectively. Even in the year 1940, with a rainfall of 16.96 inches up to the first week of October, the September rainfall was unsatisfactory, amounting only to 1.09 inches received in a single shower at the end of the month.

The object of dry-farming, for this or any other area, may be defined as "to catch, hold and use all the rain that falls." In the arid areas of Rajputana and other parts of north-west India, the attainment of this object presents the following difficulties:--

(a) Not only is the average rainfall low, but only 8 to 10 inches of rain can be expected in a bad year.

(b) The farming system must be such that both large and small individual falls of rain can be dealt with, and long irregular intervals between showers tolerated.

(c) There are strong winds.

In areas of this type, the importance of the cultivated fallow as a moisture-conserving measure cannot be over-emphasised. Experience at the Rohtak Dry-Farming Station is illuminating on this point, as the following yields of pearl millet or *bajra* in 1938 and 1939 show:

Yield per acre in lbs.						
	1938 (Rainfall 8·24″)		*Bajra (Pennisetum typhoideum)* 1939. Rainfall 10·20″			
			Small-grained early earing type		Medium-grained type	
	Grain.	Straw	Grain	Straw	Grain	Straw
After fallow ..	17	695	403	904	131	1,919
After a crop ..	0	125	29	88	106	1,434

Even in 1937 with a rainfall of 17.43 inches the difference between *bajra* after a crop and after fallow was no less marked—

		Grain.	*Straw.*	
After fallow	...	923	4480	lbs. per acre.
„ crop	...	358	2959	

The cultural operations carried out on the fallow plots at Rohtak may now be described—

(1) By means of the spade, or a light iron plough such as the "Hindustan," low banks or *bunds* 9 inches high were made along contours;

(2) The land was cultivated with a harrow after each good fall of rain and weeds kept down;

(3) The *Kharif* (autumn) crops were sown as early as possible.

It is of interest to compare these results with those recently published* of eighteen years' experiments at Montana, U.S.A. With an annual average rainfall of 13.26 inches and annual extremes of 6.75 inches and 25.5 inches, wheat after fallow yielded on the average 16.4 bushels per acre as compared with 8.5 bushels when wheat followed wheat.

* *Agricultural Gazette of New South Wales*, February, 1940.

Soil management being of primary importance, it is worthy of note that in these vast desert areas there is scope for tractor cultivation in the clearing of trees and scrub, in the making of ridges in the first preparation of new ground, and in such tillage practices as sub-soiling to permit of deep penetration of rainwater without the subsequent loss by evaporation which inversion would cause. There is considerable scope for the improvement of bullock-drawn implements, especially by the importation of ideas or designs from other parts of India. For example, on the farm of the British Cotton Growing Association at Khanewal, Sir William Roberts, in the early days of the farm, introduced from the Deccan some bullock-drawn implements which he had modified to suit local conditions. These give excellent results in that part of the Punjab. There is no reason why the three coultered seed-drill, set for the wide spacing demanded by dry-farming methods, should not replace the single tube fixed on to the back of a country plough. But this in turn presuppose a tillage implement capable of producing a seed bed in which the three-coultered drill can work. As ridge-making implements suitable for bullock power are required, it would be well worth experimenting with such "*bund*-formers" as the one invented by Mr. Charley recently Agricultural Engineer at the Coimbatore Agricultural College in Madras, which costs only seven rupees. Larger ridges or banks can readily be constructed with tractor-drawn implements, and permit the use of another method of conserving rainfall which is well understood in some parts of India, namely, the production of crops on a considerable area below a bank, the sub-soil moisture being maintained by seepage from above the embankment, which checks the run-off. The author has seen one such area in Jodhpur where, on a rainfall of only 2.25 inches, 20 acres of land so situated had matured a 3-foot high crop of the great millet, *Juar,* whilst the crops on an adjoining area of 210 acres had perished. The stabilising of bunds by suitable vegetation, is an area subject to wind erosion, is another matter requiring investigation.

Assuming a satisfactory method of land treatment and a suitable crop rotation, the next point is the choice of varieties of the crops to be grown. This is important. One may say generally that the main *desiderata* are earliness and what, for want of a better word, we

may call toughness. This characteristic toughness one may expect to find in varieties which have been selected in areas, which are themselves of the desert type. Such choice of varieties is no less important in arid climates even when irrigation is practised, and several examples have come to notice under Canal Colony conditions. Perhaps the most striking is the behaviour of the variety of cotton known as Sanguineum 119, selected by the Punjab cotton breeders from *Gossypium sanguineum* in the neighbourhood of Multan in the Punjab, a place of extreme heat and drought. In the season 1939, forty-nine varieties of cotton, grown with irrigation were tried at Ganganagar in Bikaner State. The outstanding success was Sanguineum 119 which gave a yield of 798 lbs. of seed cotton and 313 lbs. of lint per acre, whereas Punjab 289/43F gave only 594 lbs. of seed cotton and 184 lbs. of lint, and Punjab 289D gave 566 lbs. of seed cotton and 181 lbs. of lint per acre. Plant counts showed that the higher yield of the Sanguineum was due to its high survival rate, which was two-and-a-half times that of the 289F types, resulting in a much larger final stand of plants. Although the 289F cotton fetched a price 33 per cent. above that of the Sanguineum the latter crop was worth Rs. 76/8/- per acre compared with Rs. 63/2/- for the 289F.

In Sind, after years of trial, success has been obtained with the acclimatised American type "Sind Sudhar," which was selected in Sind from Punjab 289F, and which possesses this quality of toughness, or ability to stand up to the conditions of its environments.

For crops depending on rainfall "earliness" is more important than when irrigation is available. The following is a striking example. As a result of famine conditions in 1938 and 1939, the stocks of seed of *bajra* in the Rohtak district of the Punjab were heavily reduced. Seed was imported from the adjoining Gurgaon district and sown in 1940. The September rains were deficient and, being a later variety, the Gurgaon *bajra* did not head out satisfactorily, whereas the earlier local Rohtak variety did so and matured a crop. Similarly, in the Rohtak district, *Mollisoni* cotton, if sown on the winter rains in March, will ripen in October but a later cotton would not be able to do this. For this area the Punjab Agricultural Department recommends a list of selected hardy and drought-resisting types of gram, barley, wheat and *sarson* for *rabi*

sowing, and of *jowar, bajra, guara* (*Cyamopsis psoralioides*) and Moth (*Phaseolus aconitifolius*) for *kharif* sowing. Much, however, remains to be done for the great Rajputana tract. It may be possible to use some of the dwarf types of various crops which have been naturally selected in other drought-stricken areas, such as the dwarf maize grown by the Navajo Indians in America. This is always assuming, of course, that there would be no difficulty from the variety being suited to another length of day. This question of length of day has proved a stumbling block in the introduction of *jowar* types from one part of India to another, with markedly different day-length conditions.

To turn now from crops to the cattle which are of such great importance in Rajputana and Sind. Sixty per cent. of the rural inhabitants of Jodhpur State are breeders of cattle or sellers of livestock, wool, hides, milk or *ghee,* doing business both within and without the State. Parts of Sind, such as the desert Thar Parkar district, are well known as centres for important breeds of cattle. Consequently the fodder supply is very important. Given a retentive soil and a moderate amount of rain, many of the desert areas will grow excellent grass. The author has found five good species in one of the many grassland areas, known as "Jors," in the Jodhpur State. A good deal could be done by working out systems of management for such grasslands, which should include measures to keep down useless vegetation especially thorny shrubs, and to prevent the packing of the soil, the reseeding and replanting of denuded areas with good species, and the devising of schedules of cutting and grazing. At Palri in Jodhpur, stumps of the best local grass *Dichanthium annulatum* were planted, 3 feet apart, in lines 5 feet apart, in the year 1937. The two following years were famine years, and yet the planted area not only survived but gave a yield of about 930 lbs. of dried grass per acre on 8 inches of rain. In a good year four times this yield would be obtained. An area sown with seed of this species was equally successful. This grass, which used to be called *Andropogon annulatus,* is widely distributed and greatly valued over western, central and northern India.

Throughout India, in all sorts of climatic conditions, trees are used to produce fodder for cattle, but in desert conditions trees take on a special importance. A list recently prepared by the Silvi-

culturist at the Forest Research Institute gives the names of 89 species classed as good fodder trees, 131 as medium forest species, and 171 as poor or unclassified. The classification was based on the popularity amongst local graziers of the different trees which are commonly lopped for fodder in the reserved forests. The opinions were collected and collated by Divisional Forest Officers and the Provincial Silviculturists.

The Silviculturist adds: "It will be necessary to select from the list trees which, besides being good fodder trees, are likely to give high yields of fodder and, above all, are suitable to the climate and soil of the locality in which it is proposed to grow the fodder plantations."

In desert areas the immediate needs are organised effort to develop plantations of fodder trees and the working out of a scientific system of lopping.

Mention should here be made of the system of irrigated fodder tree plantations common in Sind, especially in the non-barrage areas of Lower Sind. The tree used is *Acacia Arabica, babul,* the bark of which is an important tanning material. Such plantations often arise naturally from seeds which have passed through browsing goats, and are really naturally occurring groups of trees which have been protected. But in many instances the *babul* seed is broadcast with seed of *jowar* or *bajri* or is sown in lines 30 feet apart within a crop of *jowar* and *bajri*. The cereal crop protects the seedlings from camels and goats in the first stage. After the grain crop is harvested the *babul* seedlings make rapid growth and require no irrigation till the next *kharif* season, when two or three floodings to a depth of about 6 inches are enough and the plantation is fenced. Lopping can start about the fifth year, and the plantation is usually cut out about the fifteenth year and the land taken back into ordinary farming, another plantation being started elsewhere. Given a good start, *babul* trees will survive and grow in conditions of very defective rainfall. At Hissar in the Punjab, Captain Read planted in borrow pits *babul* seed that had been soaked in liquid manure to soften the seed coat. No artificial irrigation was given and the total annual rainfall in the four succeeding years was 9.23, 22.61, 6.22 and 9.66 ins., the distribution being bad even in the year of good rainfall, and acute famine conditions prevailed in the district; yet these trees

lived. The characteristic fodder tree of Jodhpur (*Prosopis spicigera*) is worth special planting and scientific lopping, especially as *jowar* is said to grow up to, and along with, this tree. Another fodder tree, the *mesquite* (*Prosopsis juliflora*). has been introduced into India more than once in the last thirty years. It is bushy, and as it has large spines the branches are not useful as fodder, but it yields a crop of edible pods. Since it tolerates alkali, it should find a place in a desert fodder programme. Citrus fruits grown in arid areas particularly the grape fruit, suffer badly from sun scorch, which might be avoided by the interposition of lines of leguminous trees like the *mesquite*, giving broken shade. The use of shade trees is familiar in tea and coffee plantations, and this practice might have possibilities in fruit plantations in arid regions, when irrigation water is available and there is no question of competition for soil water.

While still on the fodder question, mention should be made of the possibilities of growing spineless cactus as an emergency fodder. In the greater part of India the common prickly-pear (*Opuntia elatior*) has been wiped out by the variety of cochineal insect known as *dactylopius tomentosus*. The spineless cactus, *Opuntia decumana* is immune to this insect, as has been strikingly demonstrated at the Poona College of Agriculture. The starting of a spineless cactus plantation needs a little care and a small amount of irrigation water, but thereafter it can be left to itself, and in about two years will give as much as 18 tons of fresh material per acre. Like all other unprotected plants, it would have to be fenced against camels and goats. Following a recommendation by Captain Read after his visit to Africa, Dr. Bor, Botanist at the Forest Research Institute, Dehra Dun, and the author independently obtained cuttings of a succulent plant *Portulacaria afra* known in South Africa as opekboom or elephant's food, and both have succeeded in getting it to root. It will now be bred in suitable situations. The author considers it would be worth while also trying in India the Madagascar tree *Lemuropisum edule*.

Manuring in arid areas offers obvious difficulties. For composting there is not the same wealth of vegetable materials as in more humid zones, and shortage of water makes the process more

difficult. Nevertheless the Indore method has given good compost at the Makreda Government Farm in Ajmer-Merwara. Incidentally, an originally minded officer brought to my notice the large amount of good nitrogenous manure that could be made available from the famine labour camps so often required where rainfall is precarious. In a really arid part of the world, any means of economising water is worth consideration, and some interesting private experiments have been carried out at Mayo College, Ajmer, by Lieutenant-Colonel Howson, C.I.E., M.C. The inspiration for this work came from a leak in an underground water pipe giving less than a pint a day, which kept alive a circular patch of *dub* grass (*Cynodon dactylon*) throughout a very hot dry weather. Other observations included vegetation consisting of grass, weeds and a luxuriant vegetable marrow maintained by a small leak in a main 15 inches below ground level. Lieutenant-Colonel Howson then tried sub-soil irrigation, using 3-inch kiln-baked earthenware pipes made by the local potters at a cost of about two annas a foot. These pipes were tapered slightly at one end and the joints were left without packing. They were laid at the bottom of trenches 15 inches deep. There were at least thirty different experiments, large and small, of which three will be mentioned:—

(1) Part of the polo ground was sub-irrigated by parallel lines of pipes at 8 feet apart. Each watering took half an hour for a length of 224 yards and was repeated once in four or five days.

(2) Waste water from the washerman's platform applied by underground pipes maintained excellent celery, tomatoes, lucerne, *berseen* and oats.

(3) In another part of the garden enormous sunflowers, 10 feet high, were grown with this type of watering.

The method has many obvious advantages, of which the following may be mentioned:—

(*a*) Evaporation from the soil surface is almost entirely eliminated;

(*b*) Surface rooting weeds have little chance of establishing themselves;

(*c*) A given amount of water can be made to cover much more ground than by surface watering;

(*d*) The water is delivered in the root zone of the crop.

Preliminary rough estimates indicate that sub-soil watering would use perhaps only a tenth, and certainly not as much as a fifth, of the amount of water normally applied in surface irrigation. The land above these sunk pipes has been ploughed without damage to the pipes and with great ease on account of the softness of the damp soil. Lieutenant-Colonel Howson has since found that this system works equally well in another part of India, on medium black soil with a fair amount of clay in it. Very little seems to have been published on this type of watering. The author has been told of, but has not seen, a booklet describing this form of irrigation from tube wells in Libya, and is indebted to Sir John Russell for a short account of what appeared to be the method in a pamphlet entitled *The Crispi and Gioda Agricultural Areas of Misurate,* published by the *Ente per la Calonizzazione della Libia.* In this mention is made of subterranean tubes, but the actual method whereby the water issued from these tubes into the land was not described.

So far the applied side of the subject has been dealt with, but it needs little imagination to see what possibilities exist for the work of the pure scientist in these desert areas. Various botanical surveys, combined with ecological observations, have been made, and there are meteorological records from certain stations in arid areas. The research on the Desert Locust, financed by the Imperial Council of Agricultural Research, included work on the animal and plant ecology of the desert tracts in which the locust breeding grounds are situated. The investigations have now been closed, and the results are in course of publication. But India has no desert laboratory like that in Tucson, Arizona, where the fascinating problems of the relations of the plant to water can be studied in the natural arid surroundings. The establishment of such a station is overdue, and the staff engaged at it could collaborate fruitfully with agricultural scientists engaged in solving the practical probems of desert agriculture and fodder production, and with the staff of the Locust Warning Service, directed from the Imperial Agricultural Research Institute at Delhi, which has been established as the result of the research work referred to above.

There are many points which have not been touched on in this paper such as the fixing of dunes, the establishment of wind-breaks, and the treatment of alkali land. In conclusion, one may be permitted to express the hope that pure science and practical ability, imagination and inventiveness will surely in time fulfil the prophecy which says, "The wilderness and the solitary place shall be glad for them, and the desert shall rejoice, and blossom as the rose."

After this paper had been read, a discussion took place in which Sir Bryce Burt, Mr. F. W. Woods, Drs. Janaki Ahmmal and H. H Mann, and Mr. A. J. Gibson spoke.—*Journal of the Royal Society of Arts,* dated October 3rd, 1941.

INDIAN FORESTER

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THE GENUS *AELUROPUS* TRIN. IN INDIA

BY DR. N. L. BOR, I.F.S.

In India this genus of grasses is represented by three species which are of some importance as fodder grasses in desert areas. A reference to all available lists and floras (even one published in 1941) in India shows this genus to be very imperfectly known and the object of this note is to clear the position and to give revised descriptions of the species.

I am indebted to Dr. S. K. Mukerjee, Curator of the Herbarium, Royal Botanic Garden, Calcutta, for the loan of the material contained in the herbarium, and to Mr. V. Narayanaswami, Botanical Survey of India, for information regarding literature and other technical matters.

Aeluropus Trin.

Spikelets ovate or elliptic-ovate in shape, 4-15-flowered, sessile or subsessile, inarticulate upon their pedicels, densely crowded into globular or one-sided heads or widely spaced upon a branched or unbranched axis; inflorescence a dense spicate head or an elongate raceme or spikes. Glumes somewhat unequal, the lower the shorter, elliptic in shape, acute, mucronate or cuspidate both with hyaline shining margins, strongly nerved, hairy or glabrous, persistent. Lemmas longer than the glumes, broadly elliptic in shape, acute, mucronate or cuspidate, hairy to densely hairy on the back, strongly nerved, dorsally rounded, with broadly hyaline margins; palea hyaline, cuneate or elliptic in shape, consisting of a central oblong portion rounded above and bounded on each side by the two parallel nerves, on either side exterior to the nerves is a flap, triangular in shape, rounded and wide above tapering below to its attachment with the nerve, or flaps very narrow; lower halves of the flaps hairy or not; keels scabrid in the middle third. Rhachilla

fragile. Lodicules 2, obliquely truncate. Stamens 3; anthers small. Styles 2, free; stigmas plumose. Grain oblong or obovoid, free within the lemma and palea.

Low perennial leafy grasses with rigid stiff culms and creeping branches. Leaves distichous, short, strict, convolute, coriaceous, pungent.

There are three species in India: one *Aeluropus lagopoides* chiov. is confined to the coasts of Bombay and Madras (no specimens from the coasts of Bengal), and salty areas in the Punjab and Sind: *Ae. littoralis* Parl. is found in Afghanistan and Baluchistan, while the third *Ae. macrostachyus* Hack. is found in Baluchistan. They may be separated by the following key:

Inflorescence of globose, elliptic or oblong heads of closely crowded spikelets ... ... 1. *Ae. lagopoides.*

Inflorescence elongate, of widely spaced spikes, fascicles or solitary spikelets— ... ...

Inflorescence of several spikes of spikelets on a central axis: lemmas nearly glabrous 2.5 mm. long ... ... 2. *Ae littoralis.*

Inflorescence of spikes of spikelets, fascicles or solitary spikelets; lemmas hairy, 3—3.5 mm. long 3. *Ae. macrostachyus.*

Aeluropus lagopoides (Linn.) Chiov., Ann. Instit. Bot. Roma, 8 (1908) 375.

At perennial grass exhibiting the most diverse forms of growth. At times it is densely tufted, at others spreading widely by means of prostrate stems, not rooting at the nodes, and sending up vertical culms or a single culm from each node. Prostrate culms often very long-noded (6 cm.) or very short-noded and covered with overlapping sheaths which may become leathery and crustaceous. Culms usually slender but sometimes up to 3 mm. in diameter, smooth and polished, glabrous, single or very often tufted from the node, leafy, usually branchy; prostrate stems up to 30 cm. long, usually much shorter; leaves up to 5 cm., very exceptionally to 8 cm. long but usually

much shorter, those of the innovation shoots often only 4 mm. long, 2—4 mm. broad, lanceolate or linear-lanceolate in shape, acute or acuminate at the tip, flat or plicate and subulate in profile, strongly ribbed above, each rib bearing two rows of very short antrorse bristles, furnished at the base above with a few white hairs, very slightly rough on the lower surface but the bristles are absent; margins scabrid, hairy or glabrous on the lower surface with scattered hairs; sheaths overlapping on innovation shoots and young culms, much shorter than the internode on old culms, terete, ribbed, hyaline on the margins, glabrous or hairy, smooth, those of the innovation buds and of much-branched nodes almost triangular in shape, resembling bud scales, scarious, yellowish-white in colour, woolly; ligule a mere hairy rim.

Inflorescence a globose or oblong-cylindrical spike of spikelets up to 1.5 cm. long, seated on a ribbed scabrid peduncle. Spikelets sometimes all secund on the axis which is tough and minutely hairy. Spikelets mostly sessile, forming a true spike, but occasionally in robust plants there are 1 or 2 branches below which bear sessile spikelets, ovate in shape, 4—8-flowered, crowded, villous, pale green in colour. Lower glume, 1.5 mm. long, oblong-obtuse in shape, hyaline on the margins, 1—3-nerved, rounded on the back, apiculate, villous; upper glume similar in shape, 3—5-nerved, villous, 2 mm. long; lemma 2.5—2.75 mm. long, elliptic-apiculate in shape, somewhere broader above than below, rounded on the back, ciliate on the margins and villous on the margins and back, the hairs arising from tubercles between the nerves, 8 or more nerved; lower 2—4 lemmas sometimes empty; palea broader above than below; palea with flaps infolded, oblong-rounded in shape; flaps rounded above tapering below, when opened the palea is obcuneate in shape, 2 mm. long, villous on the keels and on the central portion on the lower half. Anthers 1.6 mm. long. Grain .6 mm. long, broadly obovoid, flattened.

This species is found on the sea coasts of Sind, Bombay and Madras and in saline areas in the Punjab, Marwar, Cutch, Baluchistan and Afghanistan. Oddly enough it has never been reported from the coasts of Orissa, Bengal or Burma.

This species has been consistently misnamed in all works, except one—Flora of Madras—known to me on Indian Botany. In Gamble, Flora of Madras, although Fischer gives the plant the correct name he cites it as Trin. ex Thw. instead of (Linn.) Chiov. Actually the name in Thwaites, Enum. Pl. Zeyl. 374, is *Ae. lagopodioides* Trin. Blatter and McCann call it *Aeluropus repens* (Desf.) Parl. and it appears as *Ae. villosus* Trin. in a list of desert plants published in 1941. The species is based upon the *Dactylis, lagopoides* Linn. published in the Mantissa (1767) p. 33 and of course the correct combination is that made by Chiovenda loc. cit.

By some botanists this species was considered to be a variety of *Ae. littoralis* Parl. The shape of the palea in both species is, however, quite sufficient to separate them with certainty. In *Ae. lagopoides* Chiov. the central portion is oblong, rounded at the top and the two flaps are broader at the top than at the bottom. This gives the palea an obcuneate truncate appearance. In *Ae. littoralis* Parl. this arrangement is reversed.

Plate 19. *Aeluropus lagopoides* (L.) *Chiov.*

A. Whole plant.

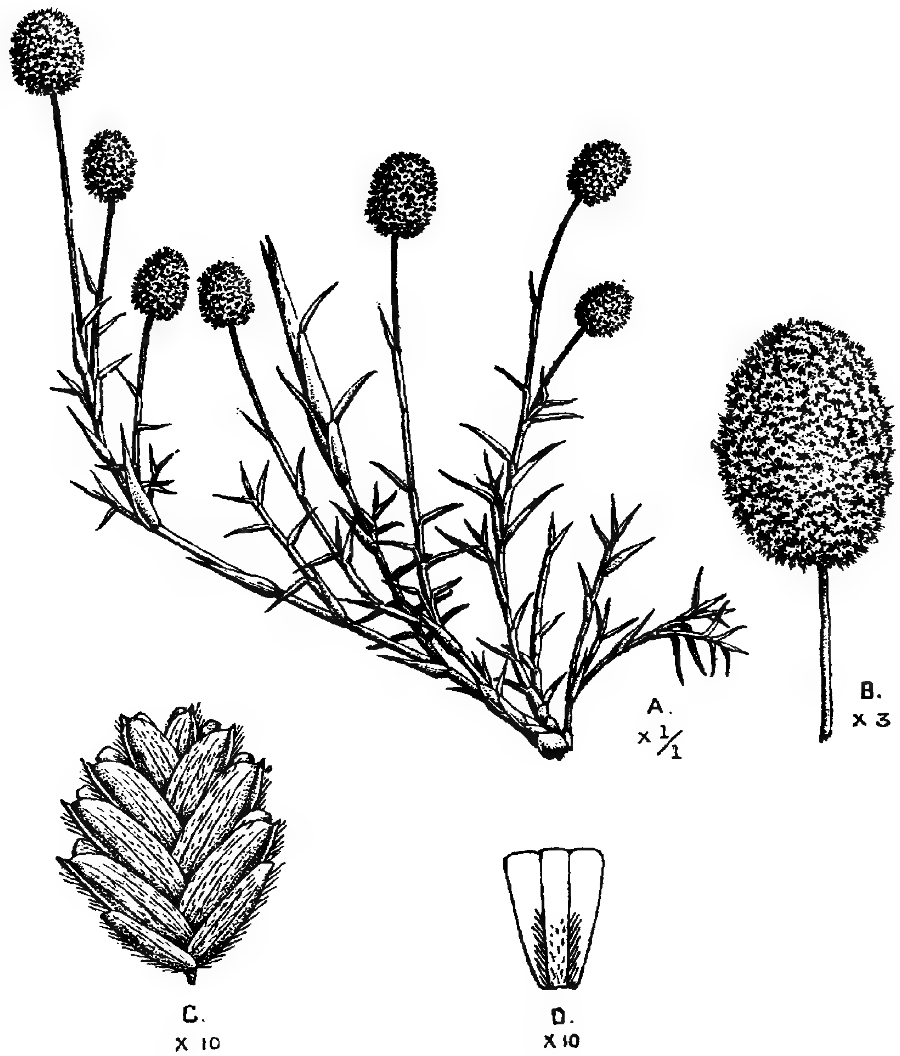
B. Inflorescence.

C. Spikelets.

D. Palea.

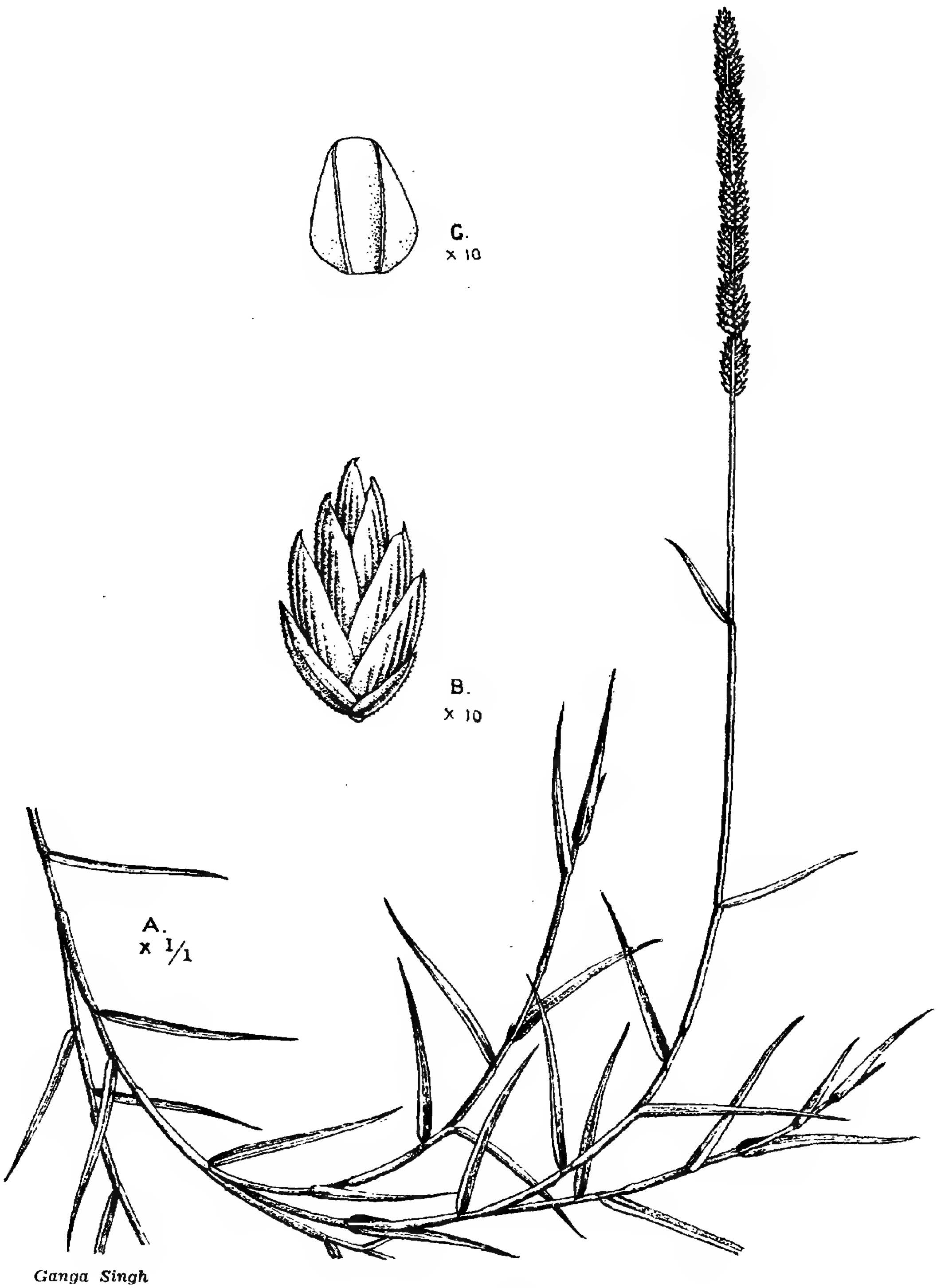
Aeluropus littoralis Parl. Fl. Ital. I. 462.

A perennial grass with many fibrous roots and creeping stems. Culms of two kinds, the prostrate creeping and the erect slender shoot from the nodes. The prostrate culms are often short-noded (this is by no means always so) and are covered with over-lapping sheaths which eventually split into fibres with age, branching and rebranching often forming a kind of bushy growth like a witches' broom with many short branches covered with distichous leaves. Erect, and sometimes also the prostrate, culms slender, smooth and glabrous, internodes much longer than the sheaths. Leaves lanceolate, rounded at the base, acuminate at the tip, up to 5 cm. long but usually much shorter, 2 mm. wide, plicate or convolute, pungent, coriaceous, strongly nerved, furnished on each nerve with 2 rows of antrorsely-directed very short bristles, scabrid on the margins, glabrous or villous with hairs from tubercles; sheaths terete



Ganga Singh

Aeluropus Lagopoides (Linn.) Chiov.



Aeluropus Littoralis Parl.

and tight or very loose and slipping from the culms, strongly ribbed, minutely scabrid, glabrous or sometimes with white villous hairs arising from tubercles between the ribs (Griffith's 6641), ciliate on the margins; sheaths on shorter short-noded stems and innovation shoot very broad with hardly any blade and hairy or glabrous, becoming conceous and crustaceous with age; liguile a hairy rim.

Inflorescence an elongate panicle 2.5—10 cm. long, consisting of a central axis on which are arranged a number of spaced spikes of biseriate secund sessile spikelets. Axis terete, ribbed, scabrid. Spikes up to 1.8 cm. long, consisting of an angled axis supporting the sessile (really very shortly pedicelled) spikelets. Spikelets ovate-oblong in shape, 6—9-flowered. Lower glume 1.25—1.5 mm. long, lanceolate in shape, 1—3-nerved, scabrid on the nerves and particularly so on the keel; margins hyaline, erose at the tip; upper glume 1.5 mm. long, oblong-elliptic in shape, almost mucronate, broadly hyaline-erose on the margins, 5-nerved, scabrid on the side nerves and very scabrid on the keel; lemma 1.75—2.5 mm. long, broadly elliptic when flattened, apiculate or mucronate, 8—9-nerved, rounded on the back, glabrous or with a very few short white hairs scattered on the back or on the margins below; palea oblong, rounded at the top, glabrous, 1.5 mm. long, 2-keeled, scabrid on the keels, flaps narrow above, infolded, broader below than above. Grain not much broader above than below, stipitate. In habit this grass greatly resembles *Cynodon dactylon* Pers. and is often mistaken for it.

This grass, in so far as India is concerned, seems to be confined to Baluchistan. In Herbarium, Dehra Dun, there is a specimen from Dalzel's Bombay herbarium marked Bel. Sup. 1196, which may possibly mean that it was collected in Baluchistan. Outside India the species is common in Afghanistan, Iran, Iraq, Persia and its distribution extends into Europe.

Plate 20. *Aeluropus littoralis Parl.*

A. Plant.

B. Spikelet.

C. Palea.

Aeluropus macrostachyus Hack. in Oesterr. Bot. Zeitschr. (1902) 374.

A perennial grass with many woody prostrate creeping stems and erect flowering and leafy culms. Prostrate stems branching at the nodes, often much branched and then the plant very tufted in habit. Vertical culms up to 40 cm. tall, of which one third may be occupied by the inflorescence, lower two thirds leafy, often with overlapping sheaths, or sheaths shorter than the internodes, scabrid especially below the inflorescence, glabrous or more or less hairy. Leaves lanceolate-acuminate in shape, rounded at the base, sometimes plicate or convolute, with the tip sharp and pungent, 1—8 cm. long, 6 mm. broad on the widest part, very scabrid on the margins, strongly ribbed and scabrid on the upper surface, scaberulous below, markedly distichous especially on vegetative shoots; sheaths shorter or longer that the internodes, teret, tight or slipping from the stems, those of the innovation buds or at much branches nodes much broader than long, with reduced blades, hairy at first, becoming smooth, polished and crustaceous with age; ligule a shortly ciliate rim.

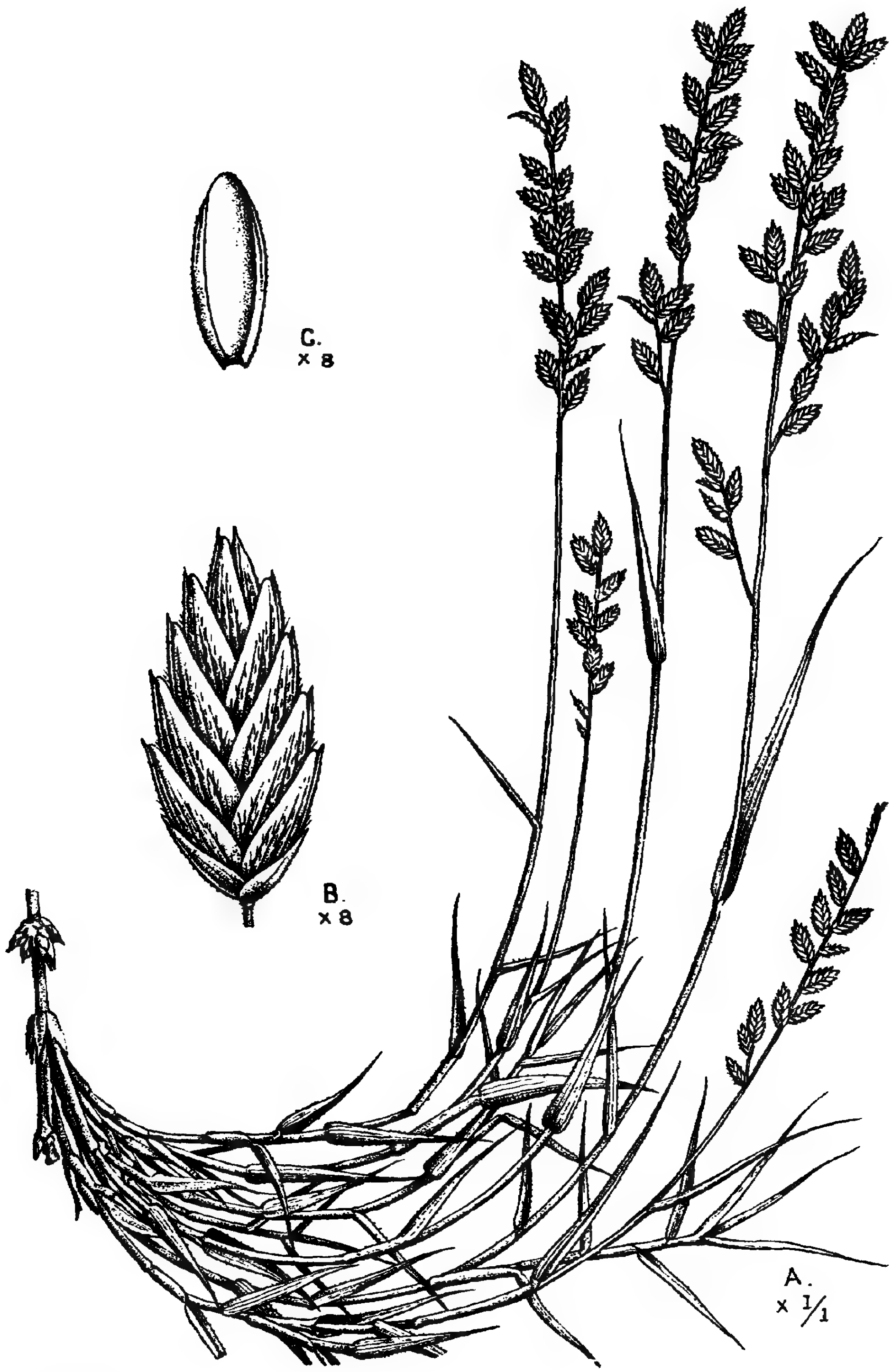
Inflorescence an interrupted narrow elongate panicle consisting of an angled and scabrid central axis with isolated or fascicled or spikes of spikelets attached to it. Spikelets ovate to oblong, up to 1.5 cm. long, 10—30 flowered collected in fascicles or crowded sessile on short side branches of a central angled and scabrid axis. Lower glume 1.5—2.25 mm. long, ovate-lanceolate in shape, with narrowly hyaline margins, 1—3-nerved, scabrid on the keel; upper glume elliptic-lanceolate in shape, apiculate, 2.25—3 mm. long, strongly 5—7-nerved, hyaline, erose on the margins; lemma 3.5 mm. long, rounded on the back, strongly many-nerved, broadly ovate acute when flattened, villous on the back in the lower half with short crisp hairs arising from small tubercles between the veins; palea elliptic in shape, erose at the rounded top, 2-keeled, scabrid on both keels, shortly hairy just at the base; flaps very narrow. Stamens 3; anthers 1 mm. long.

Plate 21. *Aeluropus macrostachyus* Hack.

A. Plant.

B. Spikelet.

C. Palea.



Aeluropus Macrostachyus Hack.

This species is found in Baluchistan and Afghanistan (Griffith's 6637). On all the Calcutta sheets is pencilled *Aeluropus grandiflorus* Munro in J. D. Hooker's handwriting. This name of Munro has never been published. The sheet in Dehra Dun herbarium collected by J. H. Lace in Baluchistan was sent to Hackel for determination. He has written on it *Aeluropus monostachyus* Hack. n. sp. but he actually published the name as *Ae. macrostachyus* Hackel. It was from J. H. Lace's specimen that Hackel drew up his description for he quotes this gathering in his account of the grass. He also mentions Griffith's specimen as follows "Griffith (ubi legit?) S. nr. 6637 at herb. Kew, anno 1869 destributum". This species was also collected by A. V. Munro at Shebo, Baluchistan, 5,000 ft., in 1893. He notes that it is locally known as *Vista* or *Murghai* and is considered a good fodder grass.

CONTOUR TRENCHING (REPLIES TO CRITICS)

By W. D. M. Warren, I.F.S.

Readers will have noticed that when writing during the last eighteen months on "Sal regeneration *De Novo*" or "The influence of forests on climate", I have particularly stressed the opinions of experts on these matters or have quoted from Text Books. Particular tendencies of the Bamiaburu contour trenching experiment have only been mentioned to illustrate some Climatic Law or factor under discussion. Yet even these references have apparently been too much for my critics, Messrs. Divekar and Habib Khan, who both seem to think that the experiment should not have been mentioned again until proof is forthcoming.

Surely, however, my critics are wrong; surely it is legitimate to mention the climatic "Tendencies" of the experiment in support of what the experts say *will* happen. It is only when breaking new ground, discovering some new scientific fact or principle that one should be careful not to "rush into print" until the facts are proved. When breaking new ground, as in the observed tendency to climatic improvement outside the forest area, I have been very careful to state the fact. Even in that case it is reasonable to sup-

pose that any climatic improvement in the forest itself, would also exert an influence on the immediate surrounding. To mention it is of scientific interest even if not of scientific conviction.

There is another good reason for mentioning fresh information or new methods of recording data, as they come along. So little is known in India in forest circles, on the correct approach to climatic problems—there is little in the Experimental Code to help in this respect—that it seems important to mention these things at the time of discovery. It will help the man whose task it will be finally to write up the Bamiaburu experiment, as well as those in other provinces who may wish to initiate research on these lines. And what better medium could one use than the *Indian Forester*? Complimentary copies of articles are filed in Research Offices for use by future investigators, so the information thus supplied is never wasted.

I had, of course, foreseen that while developing the main argument of the experts I might be subjected to a flank attack on the experiment itself, but had hoped to guard against it by references to the report written for the 1939 Silvicultural Conference. That report gives a complete background to the experiment, and had it been published in time, I feel sure my critics would have been disarmed. They would have realised that there was more behind the experiment than they give me credit for.

Mr. Divekar, for instance, tells (*Indian Forester,* dated October, 1941) the interesting story of 40 inches of rain in four days at Peint, and 38 inches in a single day at Dharampur. [Truly they get colossal storms in Bombay! !] Where he makes the mistake however is, in supposing that we are relying on individual storms for our arguments. Individual storms have been mentioned but only to illustrate and supplement, what the climatic data are showing, our chief reliance being upon signs of change in the monthly and yearly averages, of the several factors which go to make up the local climate.

Mr. Divekar need not now rely on the climatic information of that report. It is out of date, and will shortly be superseded, I hope, by an analytical study of four years' climatic data for four recording stations around Bamiaburu.

Better Utilization versus *Increases precipitation*

Mr. Habib Khan suggests (*Indian Forester*, dated October, 1941) that I am confusing better utilization of available moisture with increased precipitation. There is no confusion at all—at least not with me. I have consistently stressed that better utilization of the available moisture in forest areas leads to greater luxuriance, and that automatically to a modified climate, with the probability ultimately of increased precipitation, owing to the fact that the lowered temperatures decrease the capacity of the air for holding moisture, while increased relative humidities indicate that the precipitation point has been brought nearer. Increased humidities, and lowered temperatures are already apparent in our statistics, and two recording stations, out of the four mentioned above, are already showing appreciable increased rainfalls showing that my deductions are already coming true.

Of Mr. Thornthwaite's deductions I said: "But why place so much importance on upper air readings,—at their best they can only supplement, not replace, ground meteorological observations, and if these latter indicate that forests do bring about certain climatic improvements, one must accept them as facts as long as they have been scientifically proved." That argument is irrefutable.

Improvement to the denser damper Types

I can understand Mr. Habib Khan's difficulty in visualizing the possibility of converting "dry open forests into the more luxuriant, damper and denser types." Unless one sees these things for oneself it is rather difficult to accept such startling statements from others. My 1939 report, however, shows in detail:

(1) That certain contour trenched pole crops resulting from the clear-felling of former Q IV sal forest are now running a neck and neck race for height and diameter growth, with pole crops from former Q I trees, felled in the same year or one year earlier. I saw these crops in 1940, two years after the last measurements were taken, and the contour trenched former Q IV pole crops, still looked, as far as one could judge, slightly the more luxuriant. Even if they subsequently fell back to Quality II, they would still be economically 71 times greater in value than the former Q IV from which they have sprung! !

(2) Former blank areas, on the arid hill slopes, areas which had been "blank" for years, perhaps centuries, and which were only slowly infilling, if at all, with sal regeneration from the edges, are now filling in rapidly. Three research plots filled in to complete stocking from 40—60 per cent. of seedlings, within four years, *with no diminution in average height growth.* [One would expect such a rapid infilling to reduce the average height of all the regeneration, but apparently the existing seedlings had grown rapidly enough to counterbalance the smaller heights of the new recruits.]

(3) There was no observed dying back among the sal seedlings, during the years 1935, 1936-1937, a rather remarkable achievement for seedlings growing in what had hitherto been a severe environment. Only the 1938 seedlings rather fewer in numbers, were observed in places to be dying back, due to a rather severe hot weather, and poorer Monsoon rain than usual.

(4) The two driest known blank areas in the whole of Santara Block, itself a dry block, surrounded by poor Q V forest trees of only 30 ft. height, are now filling in with regeneration. Photographs were taken of the one area the year the trenches were dug through it. For three years it remained absolutely blank, then in the fourth year, four seedlings came in which two years later, in 1940, were one foot high. The other area, when I came to lay out an observation plot in it in 1939, was full of sal seedlings of the year before, which in the month of December had not died back.

(5) Photographs have already appeared in the *Indian Forester* in 1936 showing the luxuriance, with many vigorous shoots, of former decrepit Q IV trees.

(6) Clear felled Plots laid out in 1939, entirely removed from the climatic influence, with the control deliberately chosen as the best plot, showed a coppiced re-growth difference, in two years only, of three feet in height in favour of the contour trenched plot.

(7) Soil analyses, within and without the contour trenched area on comparable sites, show marked differences in soil moisture in favour of the contour trenched forests, indicating a greater potentiality for growth.

(8) In the contour trenched area, the sal crop is now evergreen, the new leaves appearing before the old ones fall off, whereas in

normal hill sal areas, a month to six weeks elapses after the fall of the old leaves before the arrival of the new.

In short, we have statistically proved the rapid infilling of sal regeneration to be a fact, that soil moisture shows an improvement, and that while we are not yet sure to what extent the quality of the forest has improved, which will require many replications, we are certain that the improvement will be something very substantial. Hence the claim that we are improving dry open forests to something much better, and economically much more valuable is fully justified.

I would, therefore, like to repeat what I have said so often before, that we foresters scarcely yet realize the valuable weapon for forest improvement, which lies at hand, waiting for us to summon up sufficient courage, and initiative to grasp it.

The fundamental differences between the moist mild cyclonic area of the Singhbhum forests and the extremely hot arid, and powerfully cyclonic regions of Punjab, Baluchistan, Sind and Iran, have been fully dealt with in my reply to *"Non Compos Mentis"* in the March, 1942, issue of the *Indian Forester.*

There can be little doubt that the climate of both Chhanga Manga and Chichawatni, *within the plantation areas* must have undergone considerable modification since these were established. Day temperatures must at least be cooler by the difference between shade temperatures and those of the open, and perhaps night temperatures are warmer, while relative humidities would show an increase. Then the enormous amount of extra atmospheric moisture due to evaporation from the extensive Agricultral irrigation systems, should have resulted in extra rainfall around precipitating centres, hills and forests, although it is well to remember that of all the climatic factors rainfall increase is the most difficult to prove, because the annual fluctuation is so much greater than the amount of change one could expect. Here is a fruitful line of enquiry, for the Punjab divisional forest officers to discover, if, and if so, how much, the extensive irrigation systems and the plantations have ameliorated Punjab's micro-climates within and around precipitating centres.

As for advising whether contour trenches are necessary in the Punjab plantation areas, the first essential there or anywhere else is to establish whether there is a considerable run-off or not on the area to be contour trenched, as the maximum benefits can only be obtained where the run-off is greatest. Level areas have the least run-off, and with flourishing plantations already in existence, delaying and reducing to a minimum any run-off there might have been, it is hardly likely that contour trenches would be worth their cost. The Punjab Forest Department shows the greater wisdom by confining its trenching efforts to the foot hills for increasing the fodder reserve supplies, and on the Dhamtal long jutting out spur where wood and bamboos fetch such high prices. In these localities the rainfalls are more useful ranging from 35 inches on the Upper Doab to 46 inches at Nurpur, than at Chhanga Manga so the run-off when held up would form a very useful addition to the soil moisture for growth.

Casualties on the Punjab hill slopes in plantations have also been so great that I notice Dr. Gorrie at the 1939 Punjab Conference stated quite emphatically that no planting should be attempted without the aid of trenches. That conclusion was reached by me for Bihar two years before but it is encouraging to find a contemporary independently reaching the same conclusion.

Mr. Habib Khan calls upon me to remove the ignorance of my critics. I am doing my best! I have already written far more about this epoch-making experiment than I had wanted to, and still there seems to be no end to it! Verily the words of a well-known forest officer writing of me are coming true. He said: "Either Mr. Warren is grossly exaggerating, or you in Bihar have struck one of the fundamentals of forestry." It is not for me to say how far I have succeeded in avoiding exaggeraion, though the endeavour has always been to deal with facts and deductions from them, but that the experiment goes to the very foundations of Tropical Forestry is clearly evident from its influence on so many of its different aspects. The silvicultural, economic, regeneration, afforestation, and even the climatic aspects of Indian forestry, can all benefit by contour trenching except in those fortunate areas, and they are few, where the rainfall is abundant and growth is at a maximum.

THE EVERGREEN GHAT RAIN-FORESTS OF THE TUNGA AND THE BHADRA RIVER SOURCES—II

BY DR. KADAMBI KRISHNASWAMY,

Working Plan Officer, in Mysore

Utilization of Produce.—The principal woods available in commercial quantities and extractable with profit are *Poeciloneuron indicum* and *Palaquium ellipticum.* The former is well known for its poles. The tree available in the Tunga and the Bhadra source areas is mostly of the 'black variety' and probably is *Poeciloneuron pauciflorum.* Its wood is stronger and heavier than that of the 'white variety'. The black variety is, however, shorter boled and poles from its trees will therefore be relatively short.

The other species *Palaquium ellipticum* is one of the better class of woods found in the Mysore Ghat forests, which is used for furniture in Malabar, for shingles in the Western ghats, and for door and window frames, planking, flooring and ceiling boards, rubber chests and guide skids, etc., elsewhere. It is also used to a limited extent for building purposes in the *Malnad* of Mysore. Attractive furniture is made of this wood in Calicut and other west coast towns, and some of this furniture has of late been finding its way into Bangalore market. It is also one of the woods fit for sleepers, though its power of absorbing antiseptics is said to be poor, a point, however, which bears further confirmation. It is moderately hard, even-grained, has very good working qualities and a brownish tint sometimes resembling teak. The following quotation from Pearson and Brown (Pages 669-670) and others indicate the general qualities of this timber:

"A moderately heavy, straight-grained, medium and even-textured, light red to reddish-brown wood; featured anatomically by inconspicuous growth rings or their absence, large to medium sized or small vessels borne for the most part solitary and in short radial rows of 2—4 (mostly 2) which are accompanied and frequently united by tracheids, and . . . "

"*Mechanical properties.* Wt. at 12 per cent. moisture content 43 lb. per c. ft. . . . " "In many respects *pali* is very similar to teak in strength; for instance, in transverse strength it will withstand

14,445 lb. per sq. in., teak standing 14,465. It is also approximately equal to that timber in elasticity, about 9 per cent. below it in compression parallel to the grain, and 15 per cent. harder on the end and 19 per cent. on the side."

"Moderately durable if not placed in exposed positions. The Forest Utilization Officer. Madras, writes that apparently it is not readily attacked by toredo and that it is being tried in Cochin Harbour. It is said to last fifteen years as shingles, provided they are carefully selected."

"The timber presents no real difficulties in sawing, though it undoubtedly becomes considerably harder when seasoned."

"Wood reddish-brown, moderately hard, durable"—J. S. Gamble, P. 446.

"Wood reddish-brown, durable".—Brandis, P. 424.

The wood deserves therefore to be introduced into the market, especiallly so as considerable quantities of this in its mature condition exist in the evergreen zone.

Among items of minor produce found in these forests are two varieties of cane—*Calamus pseudo-tenuis* (*halubetta*) and *Calamus* species (*jaddubetta*); the former is useful for basket making. The distribution of the kokam butter tree and of other species of *Garcinia* is meagre. Wild cardamom is rare. Mats of screw pine leaf are made locally and are said to be durable but this is not found in quantities adequate to support even a small scale cottage industry.

Silvicultural Notes on Poeciloneuron indicum (black variety) *and Palaquium ellipticum*:

(1) *Poeciloneuron indicum.*—There are two types of *balagi* known in our forests for a long time, one called locally *White Balagi* and the other *Black Balagi* (*Indian Forester*, 1938, Page 212; Kadambi Krishnaswamy). The latter is generally uncommon in the Agumbe-Kilandur zone and occasional specimens of it are confined to localities where laterite rock appears too near the surface and the soil is therefore shallow. In the Kadur ghats—the Tunga and the Bhadra source valleys—now explored, the black variety predominates the white one being scarce or absent. There are certain important morphological characters which enable one to distinguish the white

from the black variety, even after a cursory look at the trees and, as these are of practical importance to the forester in the field, they have been summarised below. It was, however, not possible to establish if there are any specific differences in the floral parts of these two kinds, which alone would satisfy the systematic botanist to accept them as separate species, as no flowers could be obtained.

The following differences have been noticed between the two kinds:

	Black Variety	*White Variety*
Adult Leaves.	$3\frac{1}{2}$ to 6 inches long, dark-green, tough, with relatively less regularly placed lateral and transverse veins.	4 to 8 inches or more long, lighter-green, tough, with close set parallel, regular, lateral veins.
Bark.	Greyish-green when young, with blackish blotches often running into one another, turning dull rusty-red with age.	Greyish-green when young, without any conspicuous dark coloured blotches, turning grey with age.
Bole.	Relatively short and branchy; often conspicuously fluted, irregular in cross section; twisted fibre more common, as also interlocked grain.	Tall, well-formed, reaching considerable heights before branching, more cylinderical in shape; twisted fibre and interlocked grain relatively less common.
Stilt Roots.	More conspicuous and anastomosing with finer ramifications, provided often with conspicuous root caps.	Less conspicuous; stilts fewer but relatively stout.

Habitat.

Generally found at the bottoms of valleys tenanted by perennial stream beds, often even within the beds, the foot of the tree being sometimes washed by running water; tolerates often shallow soil where laterite rock is found quite near the surface.

Avoids running water and prefers the slopes of valleys and ridges which are moist but well drained; confines itself to deep, well-drained forest soil.

Seeds and Seedling.

Testa darker green; cotyledons generally two, sometimes three. Seedling develops first a very powerful tap root which descends deep down into the ground and anchors it firmly in the rocky, humus filled soil; hypocotyl generally strongly arched; bearing the epigeal cotyledons; cotyledons last for more than one season and the annual shoot dies back for one or two seasons, the nourishment then required being partly met from the large, green cotyledons.

Testa relatively light in colour; cotyledons almost always two; first a strong tap root is developed which, on failing to reach adequate depth in the soil results in the death of the seedling; cotyledons do not generally last for more than one season; seedlings are relatively less hard and die off at the end of the first season if they remain inadequately established.

Wood.

Dark-brown, often approaching black, heavier and stronger; seasoning cracks less prominent.

Dark-brown but of lighter shade, hardly ever approaching black; less hard and heavy; seasons well but cracks more conspicuously.

The transition from heart wood to sapwood is abrupt.

This transition is more gradual.

(2) *Dichopsis ellipticum.*—Benth. Fl. Br. Ind. III 542; (*Pala quium ellipticum Engler*) (in Engl. u. Prantl. Pflanzenf. 4, part 1, 1897.)

Vern. names.—*Hodsale, Halusalle, Halganne,* etc.

A lofty tree of the evergreen forests reaching a height of 100 feet or more. It contributes to the top canopy layer in the Agumbe Kilandur zone, standing only next in height to *Dipterocarpus indicus* and *Calophyllum elatum,* but is the tallest tree in the Tunga valley of Tungabhadra forest where those trees are absent. The tall, cylindrical, branchless boles bear on the top roundheaded crowns which look dull green in summer owing to sparsity of foliage. It reaches a girth of 8 feet in a sound state in favourable localities. The bark is characteristically green with brown and whitish blotches, and the adult tree is recognised by its bark which cannot easily be mistaken for that of any other.

The tree thrives in altitudes from 1,500 to 3,000 feet in Mysore and is found mixed with *Poeciloneuron* in deep, well-drained, moist, sloping soil. It avoids ill-drained or water-logged localities or places where the sub-soil is impermeable owing to the presence of laterite rock near the surface. It also avoids banks of streams or edges of the evergreen forest where it passes on into blanks. It seems to be more exacting than *Poeciloneuron, Mesua* and *Dipterocarpus* on soil and elevation and is consequently confined to the best kind of locality in the ghat-head zone with heavy rainfall.

Leaves.—3 in. to 5 in. by $1\frac{1}{2}$ in. to $2\frac{1}{2}$ in., gradually narrowed into a petiole 1/2 in. long. The leaves of the tree in the Tunga valley are larger than those in the Agumbe-Kilandur zone, and the difference in size is often quite striking. (This is a matter which requiries closer examination. The blade is 4 in. to 6 in. long, narrows down into a petiole 1/3 in. to 1 in. long; the secondary nerves are prominent beneath, joined by intermarginal veins; tertiary nerves are finely reticulate.)

The leaves are elliptic-obovate, often short and obtusely tipped, sometimes notched at the apex, coriaceous, dark green above, paler beneath, glabrous on both sides; main nerves 8 to 12 pairs.

Flowers in arillary fascicles of 2 to 6 (January to March) pedicels solitary, two to six together, or more, 1 in. to $1\frac{1}{2}$ in. long, K.$\frac{1}{3}$ in.,

C.$\frac{1}{2}$ to $\frac{2}{3}$ in., dark red; A.12 to 18 stamens; filaments very short and hairy; ovary villous; style exserted; fruit berry, ellipsoid or ovoid, 1$\frac{1}{2}$ in. long, pulpy (June-July); seeds solitary; testa crustaceous.

The seeds germinate in the south-west monsoon and the oily albuminous seed has ample nourishment for the seedling which developes rapidly and attains a height of 4 in. to 6 in. in a few months. The rate of growth is then slow and will depend upon the extent to which the radicle has been able to establish itself in mineral soil; failure to do so results in the death of the seedling in the hot weather. This accounts for the death of a large number of seedlings after every seed year.

Leaf shedding, Flowering and Fruiting.—The old leaves are shed at the beginning of the cold season and are replaced by young ones almost at once. Every year is not a good seed year, but every alternate year the tree seeds copiously.

Silviculture.—The tree is a strong shade bearer, especially in its infancy and the young seedling retains its vitality for a long time in the shade of the evergreen forest, once it has established itself well.

In the *Poecilonuron-Palaquim* association, however, it suffers owing to its competition with Poeciloneuron which, by virtue of its capacity to develop a powerful tap root from the very start and its more copious seeding, often puts the latter to considerable disadvantage by occupying the soil even under the mother trees of *Dichopsis*, often entirely by its own seedlings. *Dichopsis* is also slower growing than Poeciloneuron in its early youth and consequently the weaker partner of the association is being gradually ousted out, and the climax is egging on to a purer and purer type for *Poeciloneuron*, a fact which is substantiated by the almost entire absence of Palaquium as one proceeds south from the Tunga source into the Bhadra source valley.

Good seed years being frequent and the seeds being largely fertile—percentage of germination high—the natural regeneration of *Palaquium* in the evergreen forest should be prolific, unless the seeds are sought after and destroyed by vermin. In the Agumbe-Kilandur zone, regeneration of this species is copious, but in the Tunga valley regeneration is scanty and this has to be accounted

for by the probable loss of seeds through this source of injury. Under the dense shade of the evergreen canopy the ground is sometimes carpeted with *Palaquium* seedlings in the Agumbe-Kilandur zone but such regeneration is seldom, if ever, found in the *Poeciboneuron-Palaquium* association of the Tunga valley. Established advance growth is rarely met with here, but, where a break in the top or middle canopy has let in adequate light, a few poles are occasionally seen.

The adequate natural regeneration that often attends this species in our evergreen zone obviates the need for its artificial regeneration. In the natural regeneration plot at Agumbe, and elsewhere in the Agumbe-Kilandur zone, enumerations have given very satisfactory results of the stocking of this species. The incidence of the hollowness of this species at different diameters is also low.

Timber.—The wood is reddish brown, seasons and works well, is moderately hard and durable and gives fine planks, scantlings and reepers. Weight 45 lbs. per c. ft. and strength P-472 (G. Krishnamurthy Naidu). The demand for this species in Madras and Bombay presidencies is said to be for sawn scantlings of its wood which are used for the shafts and frames of bullock carts.

The wood is not very well known, even locally, except to a small extent in the Tirtahally Taluq where it is used for buildings. It makes excellent furniture and is used for this purpose in Malabar. It will probably prove valuable for sleepers if treated with antiseptics. It is one of our good timbers which is little known in Mysore on account of our unfamiliarity with it. Rao Bahadur T. V. V. Iyer speaks of this wood as follows:

"The timber is of medium weight, straight-grained and reasonably immune from white-ants. Properly seasoned, its splitting propensities are no worse than those of other well-known timbers, especially when used in districts where the annual range of variation of humidity is not wide. It shows a marked tendency to fungus rot when used as railway sleepers, but if this could be checked by proper preservation it should make an excellent sleeper wood. Even when not treated its considerable demand from dry districts, for *Kolmarams* and *Chattams*, shows that its merits have

been recognized for house-building. That it is not in brisk demand on the Malabar coast is due to the availability of better known timbers from nearer deciduous forests at about the same price."

The wood has thus a future in Mysore and, as the tree grows to large dimensions in a sound state, it is also capable of accommodating a fairly heavy stand per acre.

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(*Concluded*)

NOTE ON CONTROLLED GRAZING IN KAMRUP DIVISION

By J. B. Rowntree, I.F.S.

In the past, endeavours were made to replace the evergreen undergrowth in the Kamrup Sal Forests by thatch (*Imperata Cylindricum*) in order to re-introduce the sal-thatch-sub-climax which prevailed before the forests were fire-protected. These attempts were very successful and cutting of evergreens and controlled burning has led to the establishment of thatch as the chief ground cover where the canopy is sufficiently open.

This thatch became full of sal natural regeneration. Under Bor's Plan, however, the groups were made too large and in the early years of the uniform system that was subsequently introduced, the canopy was opened up too rapidly, with the result that the thatch became very thick and dense before the seedlings could establish themselves. In places the thatch was 6 ft. to 7 ft. high

and in many places the sal seedlings appear to have been killed or at any rate suppressed. In some places *Eupatorium* came in, which was a blessing in disguise because it suppressed the thatch but acted as a useful nurse for the sal seedlings. Where the *Eupatorium* is hard pulled in the rains the seedlings are usually able to establish themselves before the thatch can catch up again but sometimes the thatch again takes control if the canopy is too open.

A method was sought for reducing the intensity of the thatch, as early burning was not found to be sufficient for the purpose. Somewhat naturally the use of village cattle for grazing these areas was thought of and attempts were made to use grazing as a means of control, especially in Singra Range by Forest Ranger M. N. Pait, but great difficulty was found in getting the cattle to graze this coarse thatch. This difficulty was finally overcome by the ingenuity of Forester Gatiram Das who evolved a method of treating the thatch with salt which was then greedily devoured by the cattle. The method is briefly as follows:

There are two methods of spreading the salt: (*a*) in the initial stages where the thatch is high, and (*b*) later when the height of the thatch has been somewhat reduced.

In (*a*) gunny bags are soaked in salt solution and then dragged over the thatch by means of ropes tied at either end.

In (*b*) salt solution is sprinkled over the thatch by means of leaves dipped into the solution. A watering-can would probably give more uniform results.

The cattle are driven into the area as soon as the treatment with salt has been completed and must be kept well dispersed over the area. Good results will only be obtained on dull days preferably when there is slight rain. On hot days the cattle will not enter the high thatch. The only ill-effect suffered by the cattle appears to be that if grazed too much on the coarse thatch they are apt to get sore mouths.

The above procedure is repeated every ten days or so throughout the rains until the thatch has been reduced to knee height approximately 18 ins. and thereafter whenever necessary to retain it at this height.

The following points should be borne in mind.

1. The thatch should be left a little higher than the average height of the seedlings over the area otherwise the seedlings are liable to be browsed if the salt falls on their leaves.
2. The salt must be spread uniformly.
3. Grazing must be done uniformly and under control.
4. Buffaloes should not be used.
5. If near at village the areas should be fenced to prevent uncontrolled grading taking place. Two strands of barbed wire, the lowest 18 ins. above ground level and the upper one at 3 ft., are found to suffice.
6. If the thatch is mixed with *Eupatorium* grazing should be done early in the season or just after the *Eupatorium* has been weeded, otherwise the *Eupatorium* interferes with the grazing.

The cost works out to about Rs. 10 per 100 acres as follows:

		Rs.		
Price of 20 seers of salt	...	2	6	0
Labour ...	...	8	2	0
	Total	10	8	0

but it must also be remembered that the subsequent cost of pressing and early burning is greatly reduced and that tending operations are much simplified.

Estimated damage to seedlings is about 25 %, the damaged seedlings having their tips browsed, but it must be remembered that if such areas are pressed and burnt early, practically all shoots are burnt back to ground level.

When the thatch is not very coarse, grazing without salt solution can be done quite successfully if this is started within April and May, but in such cases the seedlings are usually much the same height as the thatch and so grazing must be light if they are not to be damaged. Moreover, if the area is large it cannot all be grazed soon enough and salt solution has to be used for the balance portions where the thatch has become dense before it could be grazed.

This system has only been in force for one season so far in Kamrup, so that it is too early to say how successful it will be in accelerating the establishment of sal seedlings in the area. It has, however, proved to be very successful in bringing the thatch under control in large areas with very little damage to the sal seedlings. Such areas previously contained an impenetrable sea of thatch 6 ft. to 7 ft. high, whereas now one can walk through them with ease and the seedlings now have plenty of light and air. The first season the growth of even the undamaged seedlings was not very great, but this is probably due to the fact that they had not adjusted themselves to the changed conditions as regards light.

Experimental plots have been laid out for studying all these points in detail.

LATERITE, ITS PETROLOGY AND RELATION TO PLANT GROWTH

By S. S. Dhareshwar,

Range Forest Officer, Honavar, N. Kanara

Summary.—As basalts are believed to be the chief basic rocks which alter into laterite, their origin is briefly described. The several theories about the origin and development of laterite have been stated and their merits considered. The writer's own views about the origin of laterite have been set forth. He believes that the residual soil stratum over the highest volcanic flows was metamorphosed by the ultimate lava flows that must have occurred at different times in different places, and the scoriae together with the baked and friable upper layer was denuded in the long march of time.

The processes of weathering and leaching further altered the stratified subsoil into the petrological mass which is called the laterite. The writer is of the opinion that the true laterite is not perhaps forming at the present day, as what is found at the surface is but the subsoil laterite formation exposed on account of continuous erosion. He also believes that the red soil layers overlying the true laterite, instead of being a transition stage of the rock, is only the soil resulting from the process of weathering of the underlying laterite coupled with leaching out of the bases.

The capacity of laterite to maintain the moisture contents as also the slivicultural treatment that may be best suited to such soil with a view to maintain the soil quality have also been considered.

The laterite is often so complex in its formation that its stratigraphy baffles the forester in his silvicultural practice. The writer has the privilege of serving in the Kanara coastal tract for five years now and the following account is the expression of his attempts to

know the petrology of the laterite which is the prevailing underlying rock along the coast. It is exposed as sheet rock in varying extent here and there which fact is due to the effects of erosion. It is widely spread along the crest of the Sahyadris, while in more inland parts it caps the hills in detached patches.

The term "laterite" takes its origin from the latin word "later" which means a brick. As described by Wadia, "laterite is a kind of vesicular clayey rock, composed essentially of a mixture of the hydrated oxides of alumina and iron with often a percentage of other oxides, chief among which are manganese and titanium oxides. The two first-named oxides are present in variable ratios, often mutually excluding each other; hence we have numerous varieties of laterite which have bauxite at one end and an indefinite mixture of ferric hydroxides at the other. The iron oxide generally preponderates and gives to the rock its prevailing red colours. . . . At some places again the iron is replaced by mangaese oxides as in the case of the laterite cap over the Dharwar rocks.

Origin and Development of Laterite.—Before dealing with the laterite, the basic stratum on which it rests has to be considered. In Kanara it rests mainly on trap. "It also overlies granite, tranitory rocks and even sandstone." The trap which is one of the basalts is much believed to have been the origin of laterite. It is an igneous rock and is the prevailing basic stratum in the Deccan. Geology shews that the peninsula of the Deccan, as it exists to-day, is a part of the land surface gradually raised above the ocean in the past ages. It is interesting to note that the deposit of rounded stones, pebble and shingle found at the bottom of a well 50 feet deep sunk at an elevation of about 100 feet in Honavar, over a mile inland from the seaboard goes perhaps to support the theory that even this part of the land had emerged out of the sea. The mountains in the peninsular Deccan are mostly of a "relict" type and are supposed to be "the mere outstanding portions of the old plateau that have escaped somehow the forces of denudation and erosion that have cut out all the surrounding parts of the Peninsula." The fissure lava of the Deccan is the largest known and it covered nearly 200,000 square miles with a layer almost a mile thick. Volcanoes usually stand near the sea and the eruptions occured at intervals.

The quiescence that followed such eruptions gave scope to sedimentary bands being formed over the lava flows which were thus interstratified with the latter and have been described as intertrappean beds which are as much as 20 ft. in thickness. The Deccan trap is of subaerial origin and not subaqueous. The subaerial origin of it is proved by the existence of fresh water beds in the strata. It is estimated that "the Deccan traps were poured out in the interval between the middle Gretaceous and the lower Eocene age" and an immense period of time was occupied by the accumulations of the successive volcanic outbursts. Long intervals of time also must have elapsed between successive flows which fact is proved by the fossiliferous intertrappean beds.

The laterite is found capping the "highest" flows of the Deccan traps. The height at which it is found varies from 2,000 to 5,000 feet. In thickness the laterite cap varies from 50 to 200 feet. The lateral extent also varies and in some cases it is very extensive. There are two types of laterite: High Level and Low Level laterite.

Theories of Origin.—It is believed that the laterite in all the different places probably had not a common origin. The various hypotheses of its origin advanced are as follows:

(*i*) It is a detrital rock of volcanic origin, considering its vesicular structure and its association with basalt and its iron contents.

(*ii*) It is "a sedimentary formation deposited under running water or in lakes and depressions on the surface of traps."

(*iii*) It is the result of subaerial alteration in situ of basalt and its variants and other aluminous rocks under warm, humid and monsoonic conditions.

(*iv*) It is believed to have been the result of stratification due to the process of leaching under the alternate dry and wet tropical conditions. In other words, laterite can be called only petrified earth.

The above theories can be considered serially as follows:

(*i*) The great difference that exists between the composition of all scoriaceous volcanic tuffs and that of laterite fails to account for this hypothesis. No laterite beds interstratified with traps have been discovered.

(*ii*) Medlicot and Blanford say "The idea of its (laterite) being a marine deposit can scarcely be entertained: there is not a shadow of evidence in any part of India to render it probable that the whole of the great trap plateau had been beneath the sea in Tertiary times. It is inconceivable that fluviatile deposits should be so enormously extended, yet so thin."

(*iii*) (*a*) The apparently sedimentary origin of laterite in Bundelkhand and elsewhere tends to invalidate the conclusion that the High Level laterite is merely the result of surface change.

(*b*) The different kinds of basic formations such as trap gneiss, dolerite, sandstone and even limestone (in Travancore) underlying the laterite rock show that it takes its origin either from several kinds of basic rock or that *it has a common origin which the underlying rock has little to contribute to.* The fact that it does not result merely from the metamorphosis of the basic rocks is proved by the uniformity of its general characters. The lithomarge layer interlying between the basic rock and the laterite stratum is but a result of infiltration of the bases to the bottom of the laterite stratum. The alteration in the top of the basic rock may take place either independently or in conformity with the weathering that occurs in the lower laterite horizon.

(*iv*) The laterite is undoubtedly the petrified earth. But to what extent the process of leaching and weathering only have been responsible for its petrification is debatable. Because—

Firstly, "numerous instances are found in which the laterite rests upon the surface of basalt which is either hard and unaltered or soft and decomposed without any appearance of a passage from one rock to another." The laterite seems to have been formed out of a soil layer mostly residual than cumulose, built on the "highest" flow of the trap, there being thereafter, a long interval of quiescence in volcanic outbursts. There did occur ultimate fissure eruptions which were scattered and of varying intensity. Therefore the lava

flows also varied in thickness, intensity and also extent. As the lava stream, whenever it poured out, rolled along over the ground, the scoriaceous surface cooled and it being a poor conductor of heat, the more solid mass below remained hot for many years. The moist heat and compression so generated altered the condition of the underlying soil stratum into a compact mass even as the limestone turns into marble, sandstone into quartzite, and shale into slate. Ages rolled on, and the process of erosion removed the overlying scoriæ together with the overbaked and friable soil mass, thus exposing the remaining portion of the altered subsoil band to further weathering. Hill tops and plateau were speedily eroded which exposed the underlying laterite under formation. This process accounts for the thinness of the laterite band. When the residual soil was poorly drained a well-defined mottling developed due to irregularity of aeration. The porcess of leaching, under the tropical conditions, further built up the real laterite having a composition and structure as it has to-day. The distribution of iron and aluminous clay in the laterite was in proportion to the perfection of leaching undergone. Thus, perhaps, originated the High Level laterite containing more of iron and less of clay which is due to imperfect leaching; whereas, on the gentler slopes and flat ground in lower localities subject to heavy monsoon conditions, the process of leaching being thorough, the bases were mostly taken down and deposited in the lower horizons. "Iron imparts a fatal weakness to rocks and minerals in which it exists due to its solubility; yet from the oxidation that it undergoes, it tends to persist and accumulate in the soil. The more iron a rock or mineral contains the more susceptible it is to weathering." This is how the High Level laterite wears out and the denudation process fast segregates it in detached small patches or boulders. The writer, thirteen years ago, came across such small rounded pockets of laterite in the Bijapur District in deep road cuttings that exposed mainly gravelly soil mixed with sandstone at an elevation of about 2,000 feet having about a mean annual rainfall of 18 inches. The fact that the laterite is now found capping some of the high hills and also in considerably low elevations may be attributed to the geological upheavals that followed laterite formation under the ultimate lava flows as described above and that is how the laterite is in places found mixed with extraneous

matter such as other kinds of rock and conglomerates. It may be questioned that in the case of the ultimate volcanic flows that caused the soil alteration facilitating formation of the laterite, no evidence is available to prove the existence of such volcanic vents. This may be due to the fact that such cones and craters must have been the first portion of the volcanic area to be eroded and it is easy to conceive that the surface erosion during a long march of immeasurable time would more than remove the last trace of "the loose materials of which the volcanoes are chiefly composed."

The reason why no laterite beds are interstratified with traps between the intervals of the flows, probably is that such eruptions in the early history of the earth must have been so frequent and heavy that the upheavals did not give scope for soil formation. If at all there was any thin soil formation in the intervals, it must have been obviously much too baked and mixed and stratified with the flows. Thirdly, over the laterite band thus formed, the surface soil was gradually built up as the constructive forces prevailed upon the destructive ones. Thus the laterite is in its natural condition, an underlying rock and in mixture with other rocks supports even some of the luxuriant evergreen forests. It is exposed only on account of denudation and subsequent erosion.

Fourthly, the existence of pipes in the laterite may be traced to the process of weathering. Oxidation increases the soil volume and thus leads to mechanical disruption. Hydration which is the accompaniment of the former, takes advantage of the loosened soil structure and the infiltration further creates the pipes. Silica in solution which has great corrosive power accelerates the tunnelling and in the pipes are deposited the sesquioxides or the oxides of iron and aluminium. Considering the cutting power of silica in solution with the percolatng water, it is little wonder if the length of the pipes often reaches a considerable length. The absence or paucity of the pipes in the laterite may be attributed to the proportion of silica in solution. The presence of siliceous nodules, often altered into quartz veins may also be attributed to the movements of the silica in solution through the laterite band. The theory of leaching as the cause of formation of the laterite perhaps only partially explains the mode of alteration the subsoil has to undergo. According to this theory, laterization should begin in the surface stratum

while on the contrary, it is found as a deeply underlying stratum except in places subject to erosion. The following account of stratification as observed in four wells sunk in the past five years in and around Honavar is in evidence of the above statement: The elevation of two of the wells situated on the top of a eroded flat spur in the town is about 100 feet. The surface soil stratum is about a foot thick; the next one which is solid laterite being 36 and 25 feet deep. Lower down is found siliceous clay mixed with quartz, pebbles and softer stones in a horizon of 4 ft. and 20 ft. respectively. In the latter well having a total depth of 50 ft. the lowest four feet layer of ferrugenous clay was mixed with a distinct deposit of submarine pebbles and shingle, as stated above. The 3rd well in Honavar sunk in a hollow in the hill slope, is very interesting stratigraphically. The first horizon consisted of 10 feet of muram soil, the next one being solid laterite 18 feet deep, having longitudinal cracks. The third one was represented by a six-inch thick band of hard, grey granite and on breaking through it, a layer of golden yellow earth was found from which rose the springs. The hard laterite of the second horizon directly rested upon the granite band, there being no transitional rock or altered layer interposed between them. The yellow earth underlying the band of hard rock might have been the metamorphosed basic rock. The fourth well situated 8 miles inland at Anilgod on a hillslope exposed 18 feet of muram soil as the first horizon, then followed a layer of solid laterite 32 feet deep through which the well was bored. Below this layer was 9 ft. deep siliceous clay mixed with schistose rock on which the kerb rests.

A word about the red soil that overlies the laterite rock seems necessary. As stated above, the term "laterite" is hardly applicable to the red or muram (gravel) soil which is but the result of the forces of disintegration and decomposition, under tropical conditions, of the underlying laterite rock. Such soil strata, therefore, do not seem to be the transition stage of the true laterite, but the outcome of an intensive process of leaching out of the bases and subsequent erosion of the overlying material. Again in places where leaching is not thorough, the tropical red soils are "often incorrectly described as lateritic, *e.g.* those usually found on basaltic rocks in which the bases are largely retained in a soluble form available to vegetation and in which the silica content is high.

Age of Laterite.—The age of laterite is not determinable with certainty. It may have been formed during several ages at different intervals of time after the earlier and heavy volcanic outbursts were over. "There are evidences however, that the more important masses of laterite were formed in the Eocene and even earlier ages." It is doubtful whether it is forming at the present day for reasons set forth above.

If this theory of the origin of laterite is not a creditable guess, it is perhaps a bold assertion for a layman to venture. Yet, the writer advances these views with a conviction in order to invite opinion in the matter so that he may be able to know the secret of laterization from authoritative quarters.

Laterite in relation to Plant Growth.—It is perhaps an erroneous idea that the laterite in its natural condition is infertile. Its vesicular or porous formation containing deposit of clay complex tends to retain moisture. Thus the fertility of laterite depends upon its permeability. The water being undoubtedly the most important soil factor, the laterite underlying a sufficiently thick soil stratum is not uncongenial to plant-growth. As a matter of fact, laterite under such conditions promotes an edaphic formation. On the other hand, laterite underlying shallow soil is incapable of maintaining the optimum moisture contents. The exposed surface formation is gradually stiffened by weathering. The case of quite extruded boulders is still worse. The clay contents are thoroughly leached out in rain in a short time, leaving the rock a dead petrological mass. It is perhaps possible that such an atrophied boulder can rehabilitate itself in due course if it is again buried deep enough in the earth, by way of imbibing again the sesquioxides and for that matter the requisite moisture and mineral contents to be a useful component of the subsoil. The experiment is worth a trial.

It is thus clear that the fertility, such as it is, of the underlying laterite can be conserved provided its capacity to absorb and retain moisture is maintained. In order to meet the end, a tree cover has always to be maintained on the soil suspected to have subsoil laterite. Denudation is strictly to be avoided. Under the conditions, an edaphic formation can be evolved in the area as already stated. As the soil moisture increases, the atmospheric temperature will be reduced. The occurrence of Jamba forest which is a transitory

stage on the laterite followed by *Eugenia, Schleichera* and other hygrophillous species in succession is characteristic of this formation. Once such an edaphic formation is established, it induces other important factors. The growth of weeds and evergreen herbage as ground cover follows increasing the moisture contents of the soil. The latter factor coupled with the penetrative influence of the roots of the trees promote the permeability of the underlying laterite; and highly disintegrated laterite mixed with other decomposed rocks is by no means inimical to treegrowth. Such a soil supports even good teak. This fact is also instanced by the tropical evergreen forest in which occur the magnificent *Dipterocarpus* which can be said to be the final expression of the laterite soil in mixture with other rocks.

Much depends upon the forester as regards the selection of site for artificial regeneration. The prescription of the Working Plan is better taken as a general guide and the selection of site be made as a working agreement after careful consideration of the locality factors among which the soil conditions should be given prominence. Often the existing stand (this applies to the mixed deciduous forests in the coastal tract where soil factors vary from pace to place) though it may be rich enough, happens to be a wrong indication for the species to be introduced. This is how, by a rule of thumb, some of the teak plantations in the past have been raised on pronouncedly laterite soil with the result that the growth now is thick without proportionate height and spindly. As the thin soil stratum over the laterite gets saturated in rains, teak which requires good subsoil drainage stagnates. If such areas are excluded from clear-felling they would evolve a formation, supplemented, if necessary, by the introduction of the species suited to the conditions, which ultimately would not be uneconomical. There is little to be proud of when a teak plantation in its infancy shows a rapid height growth in doubtful soil conditions. It may have to encounter a totally different soil stratum at some depth and the rate of growth may fall off. It is not common that a *mesophyte* or a *xerophyte* often withers without any apparent cause. This may be due to the highly retentive thick clay deposit underlying the soil which occurs in places under highly tropical conditions. Instances quite the reverse of the above can also be cited. Plantation raised in highly siliceous soil

which showed a hopeless growth condition at the start, may be found to improve rapidly as it grows, on striking a better subsoil horizon. Therefore, the subsoil condition should be an important factor for consideration of the forester and it would not be too much to expect that he takes a few trial pits in doubtful cases, if he does not come across in the vicinity any deep erosions or landslides in order to enable him to assess the soil factors properly.

Thus, the laterite, whose mode of origin is yet obscure, being a widespread subsoil formation in the greater part of the famous Kanara forests, deserves the attention of the researchers for a study of its stratigraphy in relation to plant-growth.

The writer is very much thankful to Mr. J. B. T. Brooks, I.F.S. Conservator of Forests, Southern Circle, and Mr. E. A. Garland, I.F.S., Divisional Forest Officer, Working Plans, Southern Circle, for a kind loan of two of the important reference books which enabled him to study the subject as far as he could and supplement his own observations. The latter's review of the article was helpful in supplying an omission originally made.

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TIMBER PRICE LIST, APRIL-MAY, 1942

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE,

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 38-0-0 per ton.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 48-0 0 to 115-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 72-0-0 to 130-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 1-0-0 to 2-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-10-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 8-0-0 to 10-8-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
,, ..	,, ..	Punjab ..	10′×10″×5″ ..	Rs. 5-0-0 to 6-10-8 per piece.
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 10-4-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
,, ..	,, ..	Assam ..	Squares ..	Rs. 60-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	Rs. 65-0-0 per ton.
,, ..	,, ..	Bombay ..	Squares ..	Rs. 32-0-0 to 80-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-10-0 to 1-0-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-11-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-14-0 per c.ft
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers..	
Indian rose-wood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 68-0-0 to 160-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-4-0 to 1-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 0 12 0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 85-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-10-0 to 1-0-0 per c.ft

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bihar ..	Logs ..	Re. 0-6-0 to 1-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-4-6 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 1-8-0 to 3-2-6 per c.ft.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 50-0-0 to 110-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-4-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-14-0 each.
,, ..	,, ..	Bengal ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-14-0 to 1-12-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers..	Rs. 6-0-0 to 7-0-0 each.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 1-8-0 to 2-4-0 each.
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-10-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-10-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 2-8-0 to 2-12 0 each.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-6-4 to 1-8-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-9-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-4-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 38-0-0 per ton.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 0-8-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 1-9-3 to 1-14-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	
Sundri ..	*Heritiera* spp. ..	Bengal ..	Scantlings ..	
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class..	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-6-0 to 3-4-0 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-8-0 to 5-1-8 per c. ft.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bombay ..	Logs ..	Rs. 88-0-0 to 340-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 6-0-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

of the precipitation with their help. That was the point of my criticism. And I gave Mr. Warren all due credit for what he had done.

I welcome facts with open arms; but draw the line at figments of the brain to which men obsessed by one idea are, alas!, too prone. Figments surely do not deserve tolerance in the domain of science.

To see the ridiculous in a given situation or argument requires the perception of fundamental incongruities which ordinarily escape most minds, until pointed out. Hence wit is so rare.

Voltaire drove pseudo-science and pseudo-religion out of the 18th Century Europe with ridicule. I would much rather be "shallow" with Voltaire than "profound" like Mr. Mirchandani.

Yours faithfully,

Nasik, Bombay: Y. R. DIVEKAR,
16th February, 1942. *Deputy Conservator of Forests*

REVIEWS AND ABSTRACTS

THE MANUFACTURE OF INSULATION AND PRESSED BOARDS, WRAPPING PAPERS AND STRAW-BOARDS

BY M. P. BHARGAVA *and* A. N. NAYER.

(Miscellaneous Bulletin No. 44 of the Imperial Council of Agricultural Research).

This Bulletin describes in detail the work undertaken by the Paper Pulp Section of the Forest Research Institute, Dehra Dun, on its investigation of the possibilities of utilizing bagasse (crushed sugar-cane) for making insulation and pressed boards, or wrapping papers. The conclusions drawn indicate that it is economically possible to manufacture insulation and pressed boards from bagasse and that if the demand for such boards in India is sufficient to support a board mill, a handsome profit on the money invested should be forthcoming. A careful study of the report is, however, advocated, as there are certain unknown factors which might influence the prosperity of such a venture, and these are discussed in full in the report.

The manufacture of wrapping papers is also technically possible, but here again the success of such a venture is stated to depend on sufficient quantities of bagasse being available at a price about

Rs. 12 per ton ex-factory. The amount of bagasse required is stated to be 9,000 to 10,000 tons per annum, and it is doubtful if this large amount can be made available within an economic radius of a prospective mill. The report merits careful perusal by businessmen and others interested in the development of new industries in India, and the authors are to be congratulated on the thoroughness of their investigation and the large amount of useful information given in the report.

The publication is well printed by the Government of India Press and contains 8 illustrations. Samples of insulation board, pressed board, and wrapping paper made from bagasse are enclosed in a pocket at the end. Copies can be obtained from the Manager of Publications, Delhi, at a price of Rs. 1/4/- per copy.

THE COORG FOREST ADMINISTRATION REPORT, 1940-41

BY THE INSPECTOR-GENERAL OF FORESTS, INDIA

Introduction.—Since writing my last review of the report I have had the advantage of touring in the Coorg forests. I said all that I had to say in general in my report on that tour and I have recently been through both the teak working plan for the eastern forests of Coorg and the sandal working plan with the Chief Forest Officer. My report says clearly what I think is at fault with the general policy but except for that I consider that the forests are well managed and that they should be an ever-increasing source of revenue.

(2) *Constitution of State forests.*—I have little to say under this except that I note that 187 miles of boundary was not cleared for want of staff and funds. I do not think this is a very adequate reason especially when you see the expenditure and revenue in paragraph 61. If boundary clearing of this 187 miles was necesary, then funds should have been provided. These forests are paying a good surplus.

(3) *Management of forests.*—The working plans for the eastern forests and the sandal were both discussed in detail with the Chief Forest Officer during my tour and the plans have recently been received and returned to the Chief Commissioner for sanction. This completes the working plans for the Coorg forests. Last year

EXTRACTS

WANDOO AS A SOURCE OF VEGETABLE TANNIN

By H. V. Marr

(Managing Director, Industrial Extracts Ltd., Perth, W.A.)

WANDOO (*Eucalyptus Redunca Var. Elata*) OCCURS EXTENSIVELY ON THE MARGINS OF THE JARRAH FORESTS OF WESTERN AUSTRALIA.

Vegetable tannins together with animal hides play an important part in world economy both in peace and war.

Every country contains, or has contained, in the past, vast resources in tanning materials.

Heavily populated centres in Europe have long since used up nature's supplies of this essential raw material. For many years the production of leather in the more densely populated countries of Europe has been dependent upon supplies from those countries possessing extensive areas of virgin forests in which the proportion of tannins permit their economical production. Such tannin may be produced in its natural state or as a commercial extract in concentrated form so that it may be transported to the centres of greatest demand.

Tanning materials used in the production of leather vary widely in their origin, quality, and chemical composition. No one type is indispensable to the tanner as each occupies its own place in the process of production of the many and varied kinds of leather produced in the world to-day.

Australia, originally the home of the Wattle Bark, cannot use this material exclusively, and has found it necessary to import large quantities of other tanning materials such as Quebracho and Chestnut to supplement Wattle or Mimosa occurring naturally within the Commonwealth.

The following are examples of some of the best known tanning material:—

Wattle extract and bark ...	from South Africa and Australia
Quebracho extract ...	from trees indigenous to South America
Cutch or Mangrove extract ...	from the Mangrove swamps in the Malay Archipelago
Chestnut extract ...	from the Chestnut forests of France, Corsica, Jugo-Slavia, Italy, and the United States
Myrabolans ...	from India
Valonia ...	from Turkey and Syria

These have generally been considered the main sources of tanning materials in the world.

The Wattle Bark and extract industry of Africa to-day is one of the most important of that country. Australia still produces sufficient Wattle Bark for its own needs, and the collection of the bark from natural forests forms an appreciable source of supply of

tanning material. No reforestation, however, takes place, all available supplies being obtained from natural regrowth.

The value of tanning materials varies in proportion to the results obtained in the production of leather. Although a raw material may contain low percentages of tannin, the composition of such tannin may be of a type which makes it a valuable necessity, and, whilst raw materials such as Mimosa Bark, Myrabolans, and Valonia, can be economically transported in their natural state on account of their high tannin content, there are other valuable sources in which the tannin exists in such low percentages that it is only possible to extract same at origin and ship the resulting product in concentrated form to countries in which it is in demand. Examples of these are Quebracho extract and Chestnut extract.

During recent years a raw material of this description has been found to occur in Western Australia, and, during the past ten years, there has gradually developed an industry engaged in the extraction of tannin from the tree *Eucalyptus redunca var. elata* (otherwise known as Wandoo) of which extensive areas exist in the virgin forests of the South-Western portion of the State.

Raw material from the Wandoo forests was originally transported distances varying from 20 to 35 miles, and it was recognised from the inception of the industry that, if this new tanning extract became a useful adjunct to the world's tanning materials and the demand increased, it would be essential to erect any additional factories closer to the source of supply of raw material.

The introduction of a raw tanning material to the leather industry is an extremely difficult operation. If such material is merely a substitution for another product which is already in ample supply, the work of introduction is still more difficult. If, however, a new tanning material contains specific properties of its own which result in an improvement in the quality of the leather produced, the task of introduction, whilst very difficult, is appreciably lessened.

Some idea of the difficulties which are encountered in the introduction of a new material can be realised when it is understood that the process of tanning heavy leather takes place over a period of many weeks until the finished product is obtained, and the introduction of a new material without very exhaustive investigation

may result in the jeopardising of the quality of many thousands of hides—especially in the case of factories where an input of from 2,000 to 3,000 hides per week is a normal run.

It may therefore be considered an accomplishment on the part of those responsible for the production of tannin extract from this Western Australian raw material that, from the preliminary investigation stage which commenced in 1932 to 1934, such results had been obtained that it was found not only that Western Australia possessed a raw material containing valuable tanning properties but also that it was possible to economically produce it, and, at the present day, from an output of 1,400 tons per annum in 1935, Industrial Extracts Limited's operations have extended to three factories, one at Belmont on the Swan River and two at Boddington, 90 miles from Perth; the output from these three factories now totalling a maximum of 8,500 tons per annum. The extract is known commercially as "Myrtan" Wood Extract.

Similar to all the Eucalyptus, *Eucalyptus redunca var elata* is selective in its habitat, and occurs on extensive areas bordering the Jarrah zone on the eastern escarpment of the Darling Range. On the edge of the Jarrah belt Wandoo is found to occur in low-lying areas, where the soil is suitable. Outside of the Jarrah belt, pure Wandoo forests occur extensively, yielding per acre as high as 30 to 35 tons of raw material suitable for the manufacture of tanning extract.

For the production of extract the whole tree is taken, including the bark, comprising the trunk and limbs down to six inches diameter at the smallest end. Many single trees yield from 6 to 7 tons of raw material.

The method of production of the extract is carried out in a similar manner to that of Chestnut and Quebracho, except that in the case of Chestnut the raw material is generally dried to reduce the moisture content, whereas, in the case of the treatment of Wandoo, the wood is utilised in the green state.

For the production of extract the raw material is disintegrated by cross-cutting in heavy duty rasping machines, which reduces the raw material to a pulp by cutting it transversely, and in this state is fed into autoclaves and the valuable tannin constituents are leached out with water by means of counter-current press leach

system of extraction. The weak liquors are concentrated in triple-effect evaporators to a gravity of approximately 1.2, and thereafter are fed into single stage finishers and concentrated to 18 per cent. to 20 per cent. moisture.

In this condition the extract is run into bags, each weighing approximately 1 cwt. which, when sewn and laid on the cooling floor, set to a solid and in this condition are capable of being transported long distances.

The following represents an approximate analysis of "Myrtan" extract, as sold on the world's market—conducted in accordance with the official methods of The International Society of Leather Trades Chemists: —

Tannin	60-63%
Non-tans	17-20%
Insolubles	1.5-2.0%
Moisture	17-20%

Colour estimated by means of Lovibond tintometer on standard solution of the extract gives results: —

3/4	Reds
10/14	Yellows

It is stated in the early part of this article that one of the principal considerations in the introduction of a new tanning material is that it should have definite properties to recommend it to users, if it is not to become merely a replacement material. The investigators originally responsible for the introduction of this new tanning material were fully persuaded that in "Myrtan" extract they had a product which had definite properties, which resulted not only in the production of superior leather but also had an additional valuable property to the tanner that of increasing the weight return per pound of hide substance tanned.

The reaction between tans and hide substance is definitely a chemical one, and from the commercial aspect it will be realised that the degree of fixation of tans in hide substance is a very important consideration governing weight return, and when such high degree of fixation is accompanied by improvement in the quality of the product produced, the advantage of one tannin material over another becomes twofold, provided it brings about the dual result indicated above.

It is to the properties of high fixation resulting in high weight return, and improvement in the quality of the leather produced, that "Myrtan" extract owes its rapid introduction and ready demand throughout the world.

Hitherto the tanning materials giving the most favourable results were Chestnut extract and Oakwood extract. With the exception of the United States, the whole of the Chestnut extract available to tanners throughout the world has been produced in France, Italy, and other countries in Europe, and, with respect to Oakwood extract, this has been largely produced in Russia, where practically the whole output is internally utilised, so that this material can be considered non-existent.

Leading authorities throughout the world, before the outbreak of War, reported favourably on "Myrtan" tanning extract with respect to its qualities for making hard wearing leather and of giving high fixation results. Since the outbreak of War, this extract has become a very useful addition to Empire tanning materials, and its usefulness will be appreciated when it is realised that no tanning extract of the Oakwood or Chestnut type is available to the British Empire at this time apart from "Myrtan" wood extract, as all previous supplies available to Great Britain with the exception of surplus stocks from the United States, came from countries in Europe which are at present time under enemy control.

Apart from its usefulness as an Empire tanning material there are other economic aspects of the establishment of this industry in Western Australia which are worthy of consideration. Land on which *Eucalyptus redunca var. elata* occurs is good agricultural land, but, unfortunately, poison plants are generally associated with Wandoo country. Eradication of this, together with the clearing, enhances the cost of making the land available. On privately owned properties appreciable assistance is given to the settler in that the timber is removed by the Company, and a royalty paid on it, which considerably assists the clearing and eradication of the poison.

The Company employs in its factories approximately 140 persons excluding fallers and contractors engaged in transporting raw material to the respective works.

Less than 5 per cent. of the output from the Company's works is utilised in Western Australia, the remainder being exported to the Eastern States of the Commonwealth and abroad, and, in these days of unfavourable trade balances requiring enhanced export trade, every industry contributing towards increasing financial returns to the Commonwealth in the form of incoming revenue, is doing a service to Australia.

Another aspect of the importance of the industry to Australia at this time is that, whereas considerable importations of foreign extracts into the Commonwealth were found necessary for the production of good leather, it is now found unnecessary to spend this money on importations, as this new addition to the tannin materials of the Commonwealth has very largely displaced these importations.

Editor's Note:

Results of chemical and practical investigations of the properties of "Myrtan" wood extract have appeared from time to time and extracts from two reports are submitted herewith:—

1. Dr. Gordon Parker in "The Australasian Leather Trades Review" June 15, 1937:—

> "Myrtan Wood Extract is a tanning material somewhat akin in its properties to chestnut. It behaves in a similar manner to chestnut, but undoubtedly produces a firmer leather. It is suitable for blending with any other tanning material and may be used at any stage of the tanning process. . . . The tannin combines well with the hide fibres, produces a warm nice colour, giving a slightly pinkish tone, but this pink colour is completely eliminated by any subsequent process of bleaching."

2. J. R. Blockey, C. H. Spiers & H. G. Beverley—"The Journal of the International Society of Leather Trades' Chemists," June, 1939:—

> "Summary. The chemical composition and the tannery behaviour, from the viewpoint of sole leather manufacture, of redunca wood extract has been investigated. The composition is favourable, viz., Tannin 65.1 per cent., non-tannin 19.9 per cent., insolubles 0.5 per cent., ash 1.9 per cent. Compared with chestnut extract, it gives a somewhat paler

leather, combines with collagen more rapidly and penetrates pelt more rapidly, but causes a somewhat slower rate of weight increase. It gives much the same yield of leather with a slightly greater degree of tannage and a slightly lower proportion of water solubles. The sole leather prepared using it alone is solid and firm. On exposure to light the leather colour darkens. The material consists chiefly of tannins of the pyrogallol class, associated with a small proportion of catechol material. On standing there is a moderate loss of tannin and non-tannins and some increase in acidity. At the same time some gummy material is deposited. The proportion of insoluble matter increases with increase of strength up to 40 deg. Bk. and then diminishes considerably."—*Australian Forestry*, Vol. VI, No. 1, dated June, 1941.

INDIAN FORESTER

JULY, 1942

A NEW GRASS FROM THE HIMALAYA

BY DR. N. L. BOR

Calamagrostis garhwalensis C. E. Hubbard et N. L. Bor spec. nov.—*C. littoræ* DC. persimilis sed ab ea spiculis majoribus et rhachilla producta differt.

Gramen perenne (?). Culmi usque ad 1-1.5 m. alti, basi geniculati et nodis radicantes, postea erecti, ramosi; rami intravaginales; internodi vaginis breviores. Vaginae laxae et culmo solutae, striatae, glabrae, scaberulae, multinerviae; intus nervi tessellati; ligula membranacea, ad 12 mm. longae, erosa; folia ad 30 cm. long, 10 mm. lata, viridia, linearia, basi angustiora, apici longe-acuminata, multinervia et internervos sulcata, marginibus scabra.

Panicula viridis, densa, decomposita, nutans, ad 35 cm. long, ex vagina superioris folii exserta. Rami verticillati; ramuli filiformes, scaberuli; pedicelli breves longique, scaberuli, filiformes, apici leviter dilati. Spiculae lanceolato-acuminatae, uniflorae. Gluma inferior 7-8 mm. longa, carinata, 1-nervia; carina scabra; margines albae, membranaceae; gluma superior, lanceolato-acuminata, 5.5-6 mm. long, 3-nervia, carina nervis scabra; margines albae, membranaceae. Lemma 3.5 mm. longum, basi 1.5 mm. latum, paene triangulare, hyalinum, 3-nervium, nonnunquam ad insertionem aristae divisum; arista ex dorsi sub apice instructa; arista 5.5-7 mm. longa, recta; palea 1.75 mm. longa, hyalina, oblongo-obtusa, 1-nervia. Stamina 3; antherae 1 mm. longae. Rhachilla producta, .5 mm. longa, longis pilis annon inchoato lemmate aristato coronata. Callus dense sericeus pilis albis 6 mm. longis.

Calamagrostis garhwalensis C. E. Hubbard et N. L. Bor.—A perennial (?) grass. Culms 1-1.5 m. tall, geniculate at the base and rooting at the nodes, afterwards erect, branching; branching

intra vaginal; internodes much shorter than the sheaths. Sheaths rather loose and slipping from the culms, striate, glabrous but scaberulous, many nerved with occasional transverse strands visible on the inner shining surface; ligule membranous, up to 12 mm. long, erose; blades up to 30 cm. long, 10 mm. wide, flaccid, bright green in colour, linear, narrowed at the base, long-acuminate above, many nerved and furrowed between the nerves, rough on both surfaces, scaberulous on the margins.

Inflorescence a green, dense, decompound, nodding panicle up to 35 cm. long, enveloped at the base in the uppermost leaf sheaths. Branches verticillate on a stout, scabrid, central axis; branchlets capillary scaberulous; pedicels short or long, scaberulous, capillary slightly dilated at the apex. Spikelets lanceolate-acuminate in outline, 1-flowered. Lower glume 7-8 mm. long, keeled, strongly 1-nerved, scabrid on the keel; margins membranous white; upper glume lanceolate-acuminate in shape 5.5-6 mm. long, 3-nerved, scabrid on keel and side nerves; margins membranous white. Lemma 3.5 mm. long, 1.5 mm. broad at the base, almost triangular in shape, hyaline, with 5-faint nerves, sometimes split to the insertion of the awn which issues from the back about 1/3 the way down; awn 5.5-7 mm. long straight; palea 1.75 mm. long, hyaline, oblong-obtuse, 1-nerved. Stamens 3, anthers 1 mm. long. Rhachilla produced .5 mm. long, crowned with a tuft of long hairs or the rudiments of an awned lemma. Callus densely silky with white hairs up to 6 mm. long.

A gregarious grass found in the Himalaya at 10-11,000 ft. Typus in Herb. Dehra Dun, No. 8945, Kirat Ram. Collected at Kedarnath 19.10.38.

Plate 22. *Calamagrostis garhwalensis* Hubb. et Bor.

1. Panicle.
2. Spikelet.
3. Lemma surrounded by hairs from the callus.
4. Lower glume.
5. Upper glume.
6. Lemma and palea, showing rhachilla.

Ganga Singh

Calamagrostis garhwalensis Hubb. et Bor.

THE BIOLOGICAL CONTROL OF EXOTIC WEEDS

BY T. V. DENT, I.F.S.

An Australian bulletin, recently added to the library of the Entomologist at Dehra Dun, gives a graphic account of the successful biological campaign against the American Prickly-Pear, an alien to Australia, which established itself in Queensland and New South Wales, and, in time, completely occupied thousands of acres of potentially valuable land to the complete exclusion of all useful vegetation.

This bulletin is by Allen P. Dodd, and is entitled "The Biological campaign against Prickly-Pear"; it was issued by the Commonwealth Prickly Pear Board in October, 1940.

The campaign against the prickly-pear in Australia is a classical example of the successful control of a very dangerous exotic weed by the introduction of selected insect enemies of the weed from the land of its origin.

To quote from the bulletin: "The problem of prickly-pear in Australia can be stated briefly as that of a vigorous, rapidly-spreading weed occupying very large tracts of grazing country, where mechanical and chemical methods of eradication were economically impracticable since the cost of treatment was greater than the value of the land. Prickly-pears are natives of the tropical and semi-tropical regions of America. Of the various species that became established in Australia, two, *Opuntia inermis* and *O. stricta,* assumed major pest importance, while other forms reached noxious weed dimensions in certain districts.

"The two main pest pears obtained their footing during the period when the country was being opened up for grazing, when population was sparse, and pastoral holdings of very large acreage. From about 1900 onward, they spread very rapidly, until the peak of this great plant invasion was reached about the year 1925. At this time roughly 60,000,000 acres were affected, of which about 30,000,000 acres comprised infestations so dense that the land was useless from a productive viewpoint. More than 80 per cent. of the occupied area was in Queensland, the remainder being in New South Wales. The pear territory has an annual rainfall of 20 to 30 inches; it comprises good grazing land, with large areas suitable

for dairying and general farm. The value of the land, before it could be improved for production purposes, varied generally between 5s. and 30s. per acre. Under the most practicable methods of chemical or mechanical treatment, dense prickly-pear could not be eradicated at a cost less than £10 an acre. Thus it will be readily understood that the application of ordinary weed control measures was out of the question. In the peak years the pest was spreading at an alarming rate. The continued cost of checking the invasion of properties was often too great a financial load for landowners; hence, year by year, more land became unoccupied and more holdings and homesteads deserted."

It is not possible to go into all the details of the war against the prickly-pear. These are described in a graphic manner in the bulletin, which is also well illustrated with photographs. Briefly, within 20 years of starting systematic investigations, the problem had been solved and the weed controlled. This successful result was attained almost entirely through the medium of the moth, *Cactoblastis cactorum,* a native of the Argentine and adjacent areas. The conquest of the prickly-pear has been due almost entirely to this remarkable insect. Its introduction brought a complete change in the outlook within a few years. Its progress has been spectacular; its achievements border on the miraculous. Great tracts of country, utterly useless on account of the dense growth of the weed, have been brought into production. The prickly-pear territory has been transformed as though by magic from a wilderness to a scene of prosperous endeavour."

Dactylopius spp. (*Homoptera*) the Cochineal insects, which have played an important part in controlling prickly-pear in parts of India, as well as various other insects, were successfully introduced to Australia, but their work in controlling the weed was completely overshadowed by the spectacular performance of *Cactoblastis*.

Biological control of insect and plant pests is a measure of potentially great importance in forestry. The method, of course, abounds in difficulties and in dangers. Anyone who is interested in the details of the practical application of this subject, could not do better than obtain a copy of this bulletin on the Australian campaign against the prickly-pear. Compared with such problems

as the control of *Lantana* (a plant pest), or the defoliators of teak (insect pests), the prickly-pear problem is relatively simple, but the principles discussed in this very readable and interesting bulletin, and the practical field measures which were adopted in the conduct of the campaign, will serve as a useful model to those interested in biological methods of pest control in all parts of the world.

Foresters who are keen on their job should be well-versed in applied forest entomology. However, until recently, the practical forest officer in India felt himself seriously handicapped by the lack of any comprehensive work on Indian forest insects, and, as a result, entomology has inevitably been neglected. Epidemics of such insects as the defoliators of teak, *Hoplocerambyx* (the sal borer), *Calopepla* (the gamari defoliator) or *Urostylis* (the champ bug) have roused local interest and passing apprehension; the search for the insect vector of the spike disease of sandal has long been a pre-occupation of forest research in Madras, but the wider ecological aspects of the universal inter-relationship of insect and plant life have only been appreciated in a very general and abstract sort of way. At present, there are very few Indian Foresters who know a dozen insects by name, but, with the appearance of Beeson's new book (the ecology and control of forest insects in India, 1941) things will change for the better, and there is no longer any valid excuse for ignorance and apathy. Beeson has approached his subject from the ecological aspect, and the second part of his book, which deals with the control of forest insects, should be read by every forester both young and old. The reader will be imbued with fresh interest and enthusiasm which, we hope, will lead to a lasting interest in a most absorbing subject.

Needless to say, Beeson discusses the subject of biological control of Indian plant and insect pests in considerable detail. Incidentally, he gives a summary of the Australian work on *Opuntia*, and describes how *Dectylopius indicus* (a cochineal insect) practically wiped out the introduced *Opuntia monacantha* in India nearly 100 years ago. Although *Cactoblastis* has proved such a spectacular success in Australia it does not follow that it would be equally effective against the same species of *Opuntia* in India, where the biological balance of insect and plant life will be quite different.

Lantana is another American plant pest which has occupied vast areas of potentially valuable land in India, and many other tropical countries. Efforts to control this weed by biological means met with appreciable success in the Hawaiian Islands and in Fiji.

The possibilities of the control of *Lantana* in India by indigenous insects have already been considered by the Forest Entomologist. The results of careful investigations (*Indian Forest Records*, Entomology Vol. VI, No. 3) lead to the conclusion that there is no indigenous insect that feeds on *Lantana* which is sufficiently manageable for the purposes of biological control. The next most profitable line of research is considered to be the introduction of the bug, *Teleonemia*, a parasite of *Lantana* in its native Mexico, and stocks of this insect have been reared in the insectary at Dehra Dun, and are now being subjected to careful host-plant trials. Before the release of the insect can be considered, it is essential that exhaustive tests should be conducted to determine whether *Teleonemia* is also a potential danger to useful plants, and when one remembers that, among other important economic species, teak belongs to the same natural order as *Lantana*, the necessity for caution is apparent. The problem of the biological control of a highly specialized group of plants like the *Opuntias* is relatively more simple than that of a species such as *Lantana*. Like their plant hosts, many of the natural pests of prickly-pears are highly specialized and will attack no other plant group, and in fact some species of *Dactylopius* are specific and will attack but a single species of *Opuntia*. On the other hand *Lantana* belongs to the *Verbenaceæ;* this and allied natural orders include many tropical tree and herb species, some of which are of great economic importance. Most of the insect enemies of these plants will thrive on a varied range of hosts, and consequently the responsibility for introducing a new exotic insect enemy of *Lantana* is heavy, and cannot lightly be assumed. We await with interest the results of the *Teleonemia* feeding trials now in progress in the insectary at Dehra Dun.

NEW OR NOTEWORTHY *APOCYNACEAE* FROM INDIA AND BURMA

BY M. B. RAIZADA, M.Sc.

The present paper has been prepared as material and data became available after examination of the valuable collections of the family Apocynaceæ in the herbarium of the Forest Research Institute, Dehra Dun. Our receipt of botanical material from Burma alone approximates 1,000 numbers annually and the percentage of undescribed species and interesting forms is comparatively very large as is to be expected in a region botanically so little known and so little explored as is that country.

During the period which has elapsed the monumental work on the Flora of British India was completed by Sir Joseph Dalton Hooker a surprisingly large number of species have been reported in Indian and foreign botanical publications which are either entirely new to science or new records for our country. In spite of the large amount of work which has been accomplished during this period the number of new forms which come to light, specially from Assam and Burma, is remarkable. In nearly every collection of specimens received from the latter country and specially from previously unexplored regions additional novelties are usually found.

In making the preliminary identifications, immediately after receipt of the material in the herbarium, many of the interesting forms are detected and described, but in this paper only the family Apocynaceæ has been taken into consideration. Practically no critical work in some groups of plants can at present be done at Dehra Dun owing to lack of pertinent literature and absence of representative collections of certain groups of plants from the neighbouring countries for purposes of comparison; in certain cases usually all available material is submitted to specialists for favour of determination and report. Frequently, specific identifications cannot be made at once, owing to lack of complete material, so that hundreds of sheets, apparently representing undescribed species and forms, remain in the herbarium and for one reason or another these will need to be considered at a later date. In general, it is not considered to be scientifically sound to describe as new, species based on incomplete material or on a single scrappy specimen.

Consequently, many of the apparently undescribed plants at present in our herbarium have to wait for a considerable time until further suitable material of these species becomes available.

The present contribution embodies the description of one new species and the names of 11 additional species previously described and now reported for the first time from this country. A number of nomenclatural changes are included in conformity with the latest rules of botanical nomenclature and critical notes are added on some previously obscure or little-known species. All the specimens quoted are deposited in the Dehra Dun Herbarium unless otherwise indicated. I am greatly indebted to Dr. N. L. Bor, Forest Botanist, for his help in the diagnosis of the new species described in this paper.

Aganosma Harmandiana Pierre ex Spire, Apocyn. Indo-Chine 109 t. 27 (1905); Fl. Indo-Chine iii 1225 fig. 136; Fl. Siam Enum. ii. 468; Tsiang in Sunyatsenia IV. 38 t. ii (1939). A cymosa (Roxb.) G. Don var. fulva Craib in Fedde, Rep. Nov. Sp. XII: 393 (1913).

So far reported from Indo China, Yunan and Siam.

"Burma, Myitkyina, Szigatawung, 1,500 ft., 13. 6. 1926 Maung Mya 2978! Scandent, flowers pinkish-white".

"Burma, Eastern Tenasserim, 300 ft., 29. 5. 1932, A. F. G. Kerr 21592! Woody climber, flowers white, in evergreen forests."

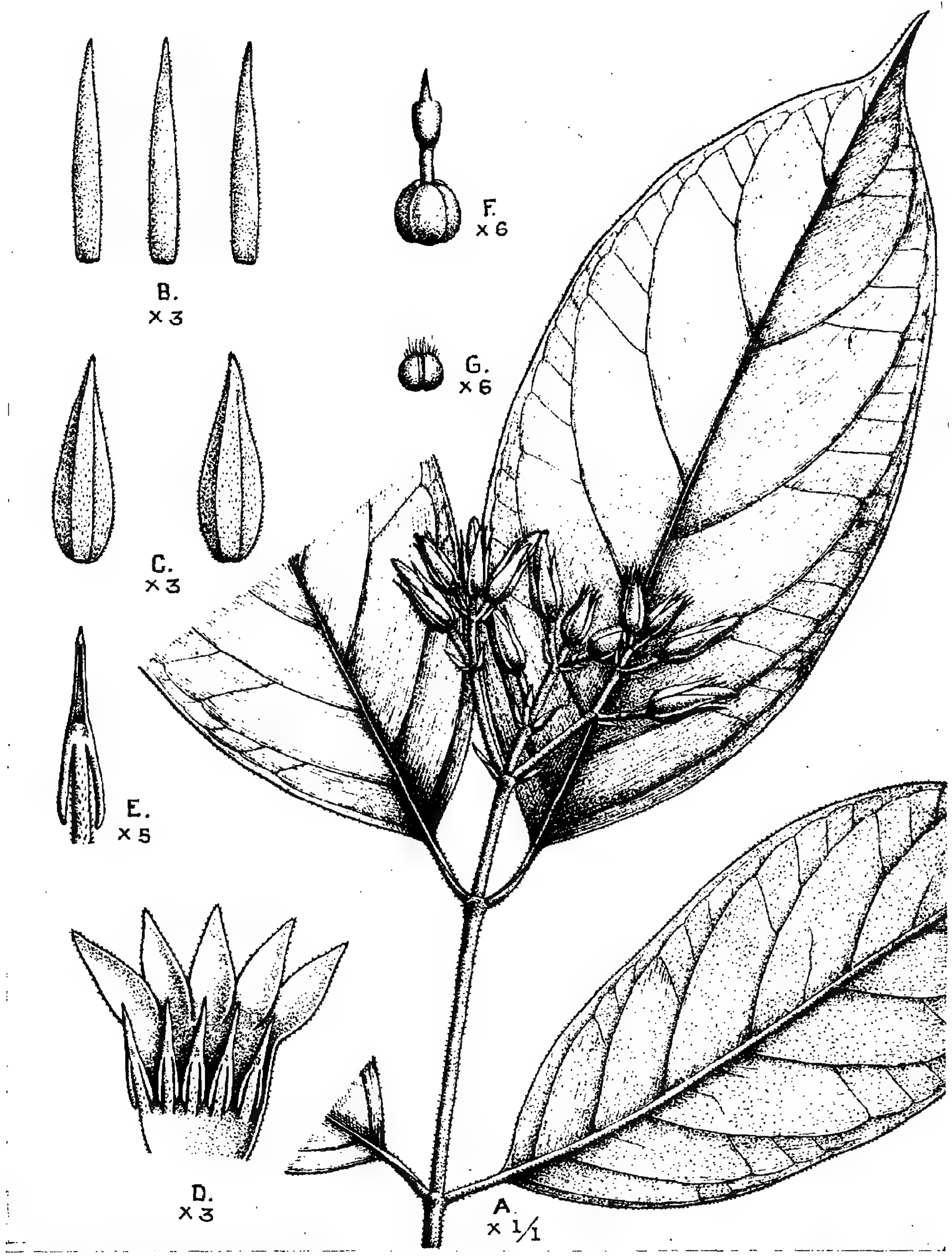
"Burma S. Shan States, Kisimansu, 2. 7. 1935, Mg. Po Khant 16342! climber with white flowers."

"Assam, Naga Hills, 1935, N. L. Bor 5063!"

In addition to the specimens quoted above I have also seen in Herb. Calcutta J. C. Prazer 11 collected from Upper Burma on 5. 6. 1926 which belongs to this species.

This species is characterized by the leaves being densely ferrugenous-tomentose beneath.

According to Tsiang, loc. cit., the type of var. fulva Craib is Kerr 277 from Doi Sutep, Siam as reported by Kew Staff. He also mentions that this var. was apparently not published. Both of his statements are, however, mistaken. Craib published his new variety in Fedde, Rep. Nov. Sp. (see above), but does not specifically mention the type. The type of A. Harmandiana Pierre is Harmand 5241 in Herb. Pierre from Siam, Udawn, Nakawm Panom.



Ganga Singh

Aganosma Lacei M. B. Raizada.

A. Flowering twig. B. & C. Calyx. D. Open flower showing corolla and stamens. E. A stamen. F. Disk with ovary, style and stigma. G. Carpels.

Aganosma Lacei M. B. Raizada sp. nov. (Apocynaceae-Echitideae). A. Hermandianae affinis sed ab ea corollae lobis intra glabris longioribus, calycis duobus lobis alatis latioribus, disco ex 5 squamis, et staminibus longioribus valde differt.

A climber; inflorescence, young twigs and under surface of the leaves covered densely with grey tomentum. Leaves opposite, entire, elliptic-oblong, acuminate, narrowed to the base, sparsely hairy above, densely grey tomentose beneath, up to 14 cm. long excluding the petiole, 4—7 cm. broad; nervation impressed above, lateral nerves 7—8 pairs, obliquely ascending, evanescent near the margin, slightly elevated beneath, reticulations obscure; petiole up to 15 mm. long, densely grey hairy. Inflorescence a rather lax terminal cyme, densely grey tomentose, up to 5 cm. long, shorter than the leaves; bracts and bracteoles small. Flowers pedicelled; pedicels up to 10 mm. long. Calyx of 5 imbricate lobes, 12 mm. long, 4 mm. broad at the widest part, minutely hairy on both surfaces, rather thicker in the middle, 2 out of the 5 lobes 12 mm. long, 4 mm. wide, ovate acuminate, the other 3, 12 mm. long, linear, 1.5 mm. broad; (the 2 ovate lobes are exactly similar to the 3 linear lobes except that they have a wing on each side). Corolla tubular ending in 5 lobes; lobes twisted to the left in bud, minutely and thickly hairy outside, glabrous on the inner surface; tube 2 mm. long, glabrous inside; lobes 12 mm. long. Stamens 5; anthers 4.5 mm. long, seated on hairy fleshy ledges down each side of which are produced the anther tails which are adnate to them; anther tails 2 mm. long; base of fleshy ledges just below the mouth of the tube. Disk 5-lobed lobes united at the base only and simulating scales, 1.5 mm. high. Ovary superior, free, hidden inside the disk, hairy at the top with longish crisped hairs. Style clavate, oblong, joining the two halves of the gynaecium, 3 mm. long, produced into a conical stigma 2 mm. long. The stamens are adnate to the stigma about 1 mm. below the point. Ovules numerous. Follicles unknown.

Burma, Maymyo Plateau, 3,500 ft., 28. 5. 1911, J. H. Lace 5251 (Holotype in Herb. Dehra Dun).

This species is related to A. Harmendiana Pierre but differs from it chiefly in the calyx, comparative length of the tube and lobes of corolla, length of stamens and above all by its peculiar disk.

Amalocalyx burmanicus Chatterjee in Journ. Ind. Bot. Soc. XIX. 80 (1940).

"Burma, Southern Shan States, Kwekike Chung Kaukkwe, 27. 6. 1935, Maung Po Khant 16339! Climber with red flowers."

In addition to the specimen quoted above and those referred by Chatterjee loc. cit., there is another sheet from Burma collected by C. B. Smales 398 (in Herb. Calc.) which belongs to this species.

Incidentally, it may be mentioned that Kerr in Fl. Siam. Enum. ii. 475 (1939) refers to Burma under the distribution of A. microlobus Pierre. I, however, take it that the specimens he examined are all A. burmanicus Chatterjee and do not exactly match with A. microlobus.

Bousigonia angustifolia Pierre ex Spire Apocyn. Indo-Chine 129 (1905); Fl. Indo-Chine iii. 1098 fig. 126 & 127; Fl. Siam. Enum. ii. 426.

Known so far from Laos, Cochinchina and Siam.

"Assam, locality unknown, native collector of G. Mann without number in Herb. Calc! A climber."

Like Pagiantha, Nouettia and Paravallaris this genus was also uptil now not reported from this country. As a good description and figures of this species have already been given in Fl. Indo-Chine any comments here are considered superfluous.

Chonemorpha assamensis Furtado in Gard. Bull. Str. Settlements IX. 115 (1935).

"Assam, loc. uncertain, May 1893, collected by a native collector under the supervision of Gustav Mann! Holo-type deposited in Herb. Calc."

This species is related to C. macrophylla (Roxb.) G. Don on the one hand and to C. fragrans (Moon) Alston on the other. From the former it differs chiefly by the very glabrous, shorter and cupuliform calyx and by the tube of the corolla dilated above the orifice of the calyx (not at the top); from the latter it is separated by the triangular lobes of the calyx and by the obovate leaves of the floriferous branches.

Ecdysanthera rosea Hook et. Arn. Bot. Beech. Voy. 198, t. 52 (1832), A.D.C. in DC. Prod. VIII. 442; Benth. Fl. Hongk. 222; Schneider in Sargent Pl. Wils. iii. 342; Ridley Fl. Malay Penin. V. 320; Fl. Indo-Chine iii. 1210, fig. '35; Fl. Siam. Enum. ii. 463.

Known so far from S. China, Hainan, Hongkong, Formosa, Sumatra, Java, Borneo, Siam and Pahang.

"Chittagong Hill Tracts, Nalbania boundary, 18. 5. 1939, T. V. Dent 88! A climber to tops of trees. Flowers pink, star-like."

This plant was first described by Hooker and Arnott based on specimens collected by Lay and Collie, Millett and Rev. G. H. Vachell from Canton, Macao, and the adjacent islands. Only recently Mr. Dent collected this interesting climber from Chittagong.

This genus is characterized by suburceolate corolla, not sub-campanulate as shown in the plate by Hooker and Arnott, loc. cit. and corolla-lobes not deflected inwards in bud.

In addition to the specimen quoted above there is also a sheet in this Herb. from Assam without the name of the collector. Mac Gregor No. 196 from Loi-mwe, 5,000 ft. S. Shan States collected in 1909 (in Herb. Calcutta) is probably also referable to this species.

Nouettia cochinchinensiis Pierre in Bull. Soc. Linn. Paris (N S.) i. 29 (1898); Fl. Indo-Chine iii. 1232, figs. 138 et 139; Fl. Siam. Enum. ii. 471.

So far known only from Cochinchina and Siam.

"Maymyo Plateau, Gokteik gorge, 2,000 ft., 4. 8. 1925, Ba Pe 1722! Climber, flowers white, the corolla lobes with a pink tinge in bud."

This is the first record of this genus from our country. According to F. I. C., Pierre first described this species in Planch. Prod. Apocy. 296 (1894), while Kerr. in Fl. Siam. Enum. and W. T. Thiselton-Dyer in Index Kewensis mention that the first place of publication is Bull. Soc. Linn. Paris (1898). In the absence of these publications from our Library I have no means of checking the above references.

Incidentally, it may be mentioned that superficially this species is very like Luculia gratissima Wall., a Rubiaceous plant.

Pagiantha peninsularis Kerr in Kew Bull. 1937, 43; Fl. Siam. Enum. ii. 441.

Previously known from Siam.

"Victoria Island, South Tenasserim, C. E. Parkinson 2052! A small tree."

The genus Pagiantha was established by Markgraf in Notizblat Bot. Gart. Berlin XII. 549 (1935) to include some of the Indian species of Tabernaemontana.

The species mentioned above is related to P. corymbosa (Roxb.) Mfg. (Tabernaemontana corymbosa Roxb. Rejoua dichotoma Gamble), from which it is readily distinguished by its few flowered inflorescence and larger flowers.

Paravallaris macrophylla Pierre ex Hua in Bull. Soc. Bot. LI. 273 (1904); Fl. Indo-Chine iii. 1180, fig. 132 ; Fl. Siam Enum. ii. 455. Vallaris? anceps Wall. ex DC. in DC. Prod. VIII. 400 (1844), Kurz in Journ. As. Soc. Beng. XLVI. 2. 254 (1877), et. F. B. I. iii, 652 nomentantum. V. anceps Wall. ex Fischer in Kew Bull. 1931, 28. V. arborea Fischer in Kew Bull. 1927, 92. Trachelospermum anceps Dunn et. Williams in Kew Bull. 1920, 343.

Known till recently from Siam, Tonkin, and Anam only.

"South Tenasserim, Ngawun Chaung forests, 300 ft. 24. 1. 1926, C. E. Parkinson 1632! A tree 40 ft. high with milky juice. Flowers yellowish-white."

"South Tenasserim, Leikpok Chaung, 400 ft. 1925-1926, C. E. Parkinson 163!"

"Tavoy, Kalamunsi Chaung, 18. 1. 1927, R. N. Parker 2440! Large shrub with milky juice!"

The writer is in complete agreement with Hua (loc. cit.) and Kerr (Fl. Siam. Enumeratio) that Pierre's genus Paravallaris should be maintained. It is more closely related to Kibatalia G. Don (to which it was recently referred by Woodson) than to Vallaris Burm. f., though several of its species have been referred to the latter genus. In fact when this plant was for the first time collected from Burma it was described as a new species of Vallaris, V. arborea Fischer loc. cit.

Trachelospermum assamense Woodson in Sunyatsenia iii. 2, 80 (1936).

"Assam, Tingab Bam jungle, March, 1899, Dr. Prain's Collector 843! (in Herb. Calc.)."

According to Woodson, loc. cit., this species is somewhat intermediate between T. Bodinieri (Levl.) Woodson, a Chinese species and T. lucidum (D. Don) K. Schum. The type is Chatterjee, S. N. April, 1902, from Chapai, Assam.

Trachelospermum auritum C. K. Schneider in Sargent Pl. Wils. iii. 341 (1916); Woodson in Sunyatsenia iii. 72 (1936).

Hitherto reported only from Yunan.

"Assam, Naga Hills, 1935, N. L. Bor 6376!"

According to King & Gamble Journ. As. Soc. Beng. LXXXIV. 2. 498 (1907) there are two sheets of this species from India in Herb. Kew, namely Hook. f. & Thompson from Khasia hills and Watt 7272 from Manipur. These are identical with Henry's 12136 from Yunan which is the type of T. auritum Schn.

According to Woodson, loc. cit., T. curtisii King & Gamble is so far known only from the Malay Peninsula and is not known to occur in India and Burma while T. auritum Schn. is a plant of south-eastern China and adjacent India. These two closely allied species having obscurely cordate leaves terminal inflorescence, salverform corolla, cylindrical stigma and laterally compressed follicles can be separated by the relative lengths of calyx tubes and corolla. In T. auritum the calyx tubes are 8-9 mm. long and the corolla 2.7-3 cm. long while in T. curtisii the lobes are only 1.8-2 mm. long and the corolla 2.5-2.7 cm. long. C. K. Schneider, consequently, grouped these two species under his subgenus Lachnocarpus in Sargent, Pl. Wils. loc. cit.

Incidentally, it may be mentioned that T. auritum Schn. which has the general appearance of Rhynchodia rather than that of Trachelospermum but with erostrate seeds seems to form a transition between the two genus Rhynchodia and Trachelospermum which if not really cogeneric are very closely related. It may, however, be noted that the former genus differs from the latter chiefly by the rostrate seeds with a caducous coma.

Winchia calophylla A.DC. in DC. Prodr. VIII. 326 (1844); For. Fl. Burma ii. 170; F. B. I. iii. 630; Ind. Trees 456. Fl. Siam. Enum. ii. 439. W. glaucescens K. Schum. in Engl. et. Prantl. Pflanzenfam. IV. 2. 125 (1895). Alyxia glaucescens G. Don Gen. Syst. IV. 97 (1837) non Wall. in Roxb. Fl. Ind. ed. Carey ii. 542 (1824). Alstonia rostrata C. E. C. Fischer in Kew Bull. 1929, 315.

Previously recorded from Siam and Burma (Thaton, Mergui and Martban).

"Amherst, Dawnas, near Misty Hollow, 2,100 ft., 27.2.1927 C. E. Parkinson 5278! Tree 60 ft. high with copious milky juice,"

The type of W. calophylla is Wallich 1607 which is in flower only. Wallich gives no indication as to the habit of the plant. De Candolle inferred from the flexuose branches that the plant was a climber. Later authors have followed him in describing the species as scandent without any additional material to go on. The specimen quoted above, is, as indicated, from a large tree 60 ft. high.

In 1929 C. E. C. Fischer described in the Kew Bulletin a new species of Alstonia, A. rostrata from Burma. This is without a doubt Winchia calophylla A.D.C. That Winchia is very closely related to Alstonia is evident from Fischer's description of Alstonia rostrata. It should be noted, however, that the carpels are connate in Winchia, and remain so in the mature fruit.

WAR SUPPLIES OF TIMBER FROM THE EAST ALMORA DIVISION

BY W. F. COOMBS, I.F.S.

Considering the great difficulties of export, the tremendous distances involved and the absence of roads, lorries, bullock carts, etc., which are common conveniences in other more accessible divisions, the extraction of colossal quantities of chir timber and *ballis* from this division best illustrates the triumph of mind over matter, of human energy over static resistance. Every single piece of timber, be it a broad-gauge sleeper or a *balli*, has to be carried on human back down steep hill slopes from the site of conversion to the launching depot, a distance of often 2 to 3 miles along veritable goat tracks. Full praise must be given to the gallant band of Garhwali and *dhotial* coolies who toil at this work for months on end. The conversion extends over a large number of scattered compartments throughout the division at distances often well over a hundred miles north and south and sixty miles east to west between individual areas. The launching depots are not always on the banks of the main floating streams, like the Sarju, Ramganga, Gori or Kali rivers. Not infrequently the produce of a batch of compartments has to travel down a subsidiary *nala* or minor stream for some 4 to 5 miles till it reaches the main stream. Here a very extensive chute, has to be prepared, dry or wet, down which the timber is slipped or slid till it reaches the main stream. All this takes time and

immense effort on the part of the labourers concerned. Once in the main stream the timber forms a *ghal* which has to be continually controlled by *mallahs* who camp along the river side, and move with it. The journey down by river takes as long as 3 to 4 months till finally the timber is caught at the Boom at Baramdeo where it is again rafted down to Tanakpur some 6 miles farther on. The total journey by water may easily be over 200 miles and a certain percentage of timber never reaches the depot, due to sinkage, petty theft en-route, breakages, etc. Finally, at Tanakpur, it is again caught and loaded into carts to take it to the depot from the river-side. From the depot it is, after examination, railed down to the required centres. If the weather is unfavourable and there are heavy winter showers, as occurred recently, the hill streams become flooded so that the management of a large *ghal* (2 to 3 lakhs c. ft.) is a most difficult matter. The timber crashes down on the Boom which may then have to be opened so as to protect it. In this event a large quantity of timber escapes the Boom and proceeds down-stream for miles. It has next to be salvaged and brought back to the depot.

In normal times, the outturn of the division is calculated as 5½ lakhs c. ft. of marked volume. In practice, the contractor obtains some 8 lakhs c. ft. actual outturn. This year there are over 10 lakhs c. ft. in the rivers, part of which has already been caught at the Boom. The division is now felling 40 per cent. extra yield, and in addition is also extracting 2 lakhs c. ft. in advance. Some one lakh broad-gauge sleepers have to be supplied to the N. W. Railway apart from large quantities for direct supply to the Defence Department. In addition, there is a supply of about a lakh of chir *ballis* for the latter and miscellaneous sizes for local consumption. In all, the division is producing about 12 lakhs c. ft. sawn timber this year, with a probable increase next year to 15 lakhs. One or two small *sal* wood contracts and of khair and deodar complete the picture. It is noteworthy that all this business has so far been done by the ordinary subordinate forest staff, which reflects much credit on them. No extra hands have been engaged. There is only one big contractor who has more or less the monopoly of the total chir timber work. Owing to the marked increase in the work, and due to labour difficulties, it is not claimed that every-

thing goes off without a hitch, but on the whole his work has so far been satisfactory, and in the abnormal times through which we are now passing, this fact has to be kept in mind. It is in fact by the willing co-operation of all hands that difficulties are overcome and success is achieved.

CONVOCATION OF THE INDIAN FOREST COLLEGE, DEHRA DUN

The Convocation of the Indian Forest College, marking the ceremonial close of its second biennial course, was held in the presence of a large gathering in the Convocation Hall of the Forest Research Institute at 11 a.m. on Thursday, 2nd April, 1942.

In the absence of the Honourable Mr. Nalini Ranjan Sarker, Member of H. E. the Viceroy's Executive Council, in charge of the Department of Education, Health and Lands, who was prevented at the last minute by official duties from attending the Convocation to present the Diplomas and Prizes, his place was taken by E. C. Ansorge, Esq., C.S.I., C.I.E., I.C.S., former Adviser to the Governor of Orissa.

In welcoming Mr. Ansorge to the Convocation, Mr. S. H. Howard, Inspector-General of Forests and President, Forest Research Institute and Colleges, said:

"Mr. Ansorge, Principal, Indian Forest College, Ladies and Gentlemen,

Last year the Rangers' Convocation was presided over by the then Hon'ble Member, Sir Girja Shankar Bajpai. I cannot let this occasion pass without reminding you what an *unfailing friend* he was to this Institute and College. Sir Girja Shanker Bajpai joined the Department of Education, Health and Lands in 1923 as Under-Secretary and held every office till he became the Member—a unique record. He knows that in America he carries the good wishes of his many friends here and the Institute and Colleges would like to congratulate him on his important post.

This year we are honoured by having Mr. Ansorge to preside over this Convocation and to present the diplomas. He is no stranger to forests and forest work because he was in charge of them in his own province of Orissa.

We extend to him a most cordial welcome. I also take this opportunity of welcoming those new students who have just arrived.

I would like to mention certain difficulties which we experience over this course. High qualifications are demanded from the students before entry but, despite these, teaching is made more difficult than it should be because it appears that botany and mathematics cannot be studied together at any course in any Indian University. Yet a ground work up to Intermediate Standard in both these subjects is required here and if every student had this ground work, much elementary teaching would be saved.

I am frequently asked both by Provinces and States to accept a lower qualification for some individual than that laid down, or to admit students over the age limit. As it is the business of this college to train the men whom Provinces and States want, I do waive the rules whenever possible. But I would like to point out that our experience indicates that students not properly qualified find it difficult to follow the course and they impede the general progress of those who are properly qualified. The same applies to students over age and we find here that a break of a year or two in studies means that students cannot resume studies again at the pace required.

May I also say a few words to those who have finished their course here and who are about to leave us. I hope they have enjoyed their two years and that they go out properly qualified members of their profession. But during the two short years at this College we try to teach them something more than the mere technical qualifications for the practice of their art. Great stress is laid on a common mess and on games, and we hope that at the end of their two years here by eating, working and playing together, these students go out imbued with that *esprit de corps* which makes foresters a brotherhood throughout the Empire.

Midst the pomp and panoply of war some of you may think that the glory of the soldier is more attractive than the more humble work of a forest officer, but I hope you will realise the importance of the work you will do. The army would find it impossible to carry on this war without forestry and forest products. Apart from obvious things like rifle stocks it demands enormous quantities of plywood for aircraft; it needs quantities of wooden containers for food, grease, and even medicines. These have been designed at this Institute and are now under trial or accepted. Medicinal creosote, essential if vast bodies of men in camps are to

be kept healthy, was not made in India and the import had practically ceased. This institute worked out methods by which that supply could be obtained from the distillation of the resinous wood of the chir pine. The stills for that distillation have now been erected and almost immediately this vital necessity for the troops will be forthcoming if it has not already started.

But apart from these special supplies, the demand for ordinary timber for the army is enormous. I do not propose to disclose for the benefit of our enemies what that demand is, but I may repeat a figure already published of one order for a set of sizes for sawn timber of half a million tons of wood or, if you prefer, for nearly a crore and a half of maunds, a quantity which placed end to end would circle the world. It is the care bestowed upon the Indian forests for the past 70 years by the old Indian Forest Service that has made it possible to supply to-day these enormous demands without undue strain. One of the great advantages of scientific forestry to any nation is the quantity of material stored up in the growing stock to meet any national emergency.

You students who are leaving us will have under your control about one-quarter of the total area of British India and this enormous tract is controlled, with the help of our provincial officers and rangers, by a total service numbering under 350. You will do much of your work in wild and lonely places. To the public eye there will apparently be little to show as a result of your whole working life of perhaps 30 years.

"The lyf so short, the craft so long to lerne,
Th' assay so hard, so sharp the conquering."

You will produce no mighty structures like the great works of the irrigation engineers and few of the material rewards and honours of this world will come your way, but in the practice of your art—and remember that it is an art rather than a science—you will eventually know that inner joy which comes to all craftsmen in the doing of the work itself."

Mr. Howard then called on the Principal for his report.

After extending a welcome to Mr. Ansorge on behalf of the staff and students of the Indian Forest College, the Principal, Mr. E. C. Mobbs, I.F.S., presented his report as follows:

REPORT OF THE PRINCIPAL, INDIAN FOREST COLLEGE ON THE 1940-42 COURSE

"To-day, Sir, marks the second milestone in the history of this College and another important milestone in the history of Forestry in India, for to-day we send out to the Provinces the second set of men trained in India for the new Provincial Forest Services, which, consequent on the grant of provincial autonomy, are being built up to take the place of the Indian Forest Service. With them also we are again sending out men trained for the Superior Forest Services of some of the Indian States.

This College was opened in May, 1938, and is to be distinguished from its very much older sister institution, the Indian Forest Ranger College, formerly known as the Imperial Forest College, which is situated in Dehra Dun and, dating to as far back as 1881, has trained Rangers for well over half a century.

The Indian Forest College was inaugurated by the Central Government to provide an institution in India where higher forest education, similar to that of the degree or diploma standards in Forestry at British Universities, could be given to candidates for the gazetted forest services of the Provinces, and for the similar forest services in the Indian States.

The course extends over two years, and under the present organization, each class completes its course before a new class is admitted. The first course was from May, 1938, to March, 1940. To-day brings us to the ceremonial close of the second course, from April, 1940, to March, 1942. In the first course there were 16 students—11 from the Provinces and 5 from States. For the second course the number was increased to 20—14 from Provinces and 6 from States.

The Provinces are represented by:

1 from Assam.
2 „ Bengal.
2 „ Bihar.
2 „ Central Provinces.
1 „ Orissa.
3 „ Punjab.
3 „ the United Provinces.

There are no students in this class from Bombay, Madras or Sind.

The States are represented by:

1 from Balrampur.
1 ,, Gwalior.
1 ,, Hyderabad.
2 ,, Kashmir.
1 ,, Mysore.

A further Punjab student was admitted for the second year of the course, bringing the total passing out to-day to 21. He had headed the list in the Ranger College class of 1939—41, and being otherwise qualified for admission was accepted for further training in this College, as a probationer for gazetted service. Much that is done in the course here is similar to that in the Ranger College, so that a man with an Honours Certificate from the Ranger College should have no great dfficulty in entering our course at the beginning of the second year. I am very pleased to be able to record that the student in question, Gurbakhsh Singh Dhillon, has been able to enter successfully into the course and into the College life generally.

The total number of students, 16 in the first course and 21 in the second course, may appear small. When the first course opened in 1938, several of the Provinces had not yet decided on the reorganisation of their forest services following the decentralization of "Forests" under the political reforms, and some were not ready to depute students to the College. It was only possible, therefore, just to make up the number of 16 students, which was considered the minimum for which a College could be economically inaugurated.

For the second course the demand for seats increased to over two dozen. The accommodation in the College could only easily be expanded, however, to take 20 students and pending the receipt of estimates of the probable future requirement of the Provinces and States, it was not considered advisable to embark on any extensive works to provide for a larger number of students. There were other dangers also to be considered in increasing the size of the class. Gazetted posts in the Forest Services of India are necessarily limited and if there is any over-recruitment this is likely to

have undesirable effects, both to the services themselves in forming a promotion block (as is now the case in some Provinces, resulting from heavy recruitment in the years following the war of 1914-18), and to the future of the College, which might suffer from a dearth of students later on. One of the causes why the Forestry School at Cambridge closed down was the almost complete cessation of recruitment to the Indian Forest Service following the period of heavy recruitment after the last war. Only 20 students were, therefore, admitted to the second course of this College, the extra one coming later, as I have already mentioned.

Estimates of the probable requirements of the Provinces and States now give an average of 24 to 28 students per course. But the great demand for forest produce for the present war, and the consequent occupation of many forest officers on special war work, has resulted in an even greater demand for seats for the next course, from 1942 to 1944. At the same time, it has to be remembered that the College is training men for permanent service and not just for war service, and the same evils as have already been mentioned would be likely to follow any over-recruitment now. A middle course has, therefore, been steered, and the next class will consist of 28 students. They are with us here to-day, and I take this opportunity of welcoming them to the College.

The College is fortunate in its excellent accommodation in the fine Forest Research Institute building of which it occupies the upper floor of the south-west wing. For the increase of four students in the 1940-42 class, additional bench accommodation was provided in the Biological Laboratory and also in the Chemical Laboratory, which is located in the separate building under the Biochemist. But to provide for the increase to 28 students for the next course fairly considerable alterations have been necessary. In the main building, the biological laboratory has been extended and is now a fine room some 57 ft. long with over 140 ft. of bench space. A new store room has also been provided. The old students' common-room has been amalgamated with the former Engineering lecture-room to make a combined drawing-hall, and a large new room has been taken over from the Silviculturist to form the new students' common-room. In the separate chemical laboratory further bench accommodation has been provided in the space formerly

used for lectures and a new lecture-room has been built as an extension to the building.

To avoid further structural alterations in the event of any further increase in the number of students, and to provide for the possibility of additional students again being admitted for the second year of the course, the accommodation now provided has been planned to take up 32 students. It is not considered likely that we shall exceed this number.

We have been fortunate in these difficult times in obtaining much of the additional equipment required. All the microscopes and other apparatus required for the biological laboratory has been secured, and much of the apparatus and chemicals required for soil chemistry. But it seems unlikely that we shall obtain all the survey instruments required. Such things as prismatic compasses are required for war purposes and are not now obtainable in the market. We have, however, sufficient of most things to enable us to carry on.

A little difficulty has been felt on account of the war as regards supply of books. Although the students have the use of the central library of the Forest Research Institute, which avoids the necessity of maintaining a separate technical library for the College, they must of course buy certain books themselves. Some of these have to be obtained from abroad. One batch of books on Forest Management which was ordered from England was apparently sunk by enemy action. Several months later we were next informed that a second consignment of these books was destroyed by bomb in the London warehouse where they were packed ready for despatch. We still hopefully await the third consignment!

For the accommodation of the 16 students of the first class, four class II officers' bungalows were converted into hostels, each housing 4 students, while a fifth one was made into a common mess. For the increase of students in the second class, the mess bungalow was converted into a hostel and a new and much better mess was provided in the building formerly used as the New Forest Club. This has proved just adequate for the class of 21 students, but would not have sufficed for any increase in numbers. The mess has, therefore, now been extended by the addition of a new dining hall and enlargement of the kitchen. Two further bungalows have

also been taken over as hostels for the accommodation of the additional students. We are grateful to the Executive Engineer, Bihar and U. P. Works Central Division, and to his staff for all the work they have done in the College and to the mess and hostels, despite the difficulties of war-time conditions.

The staff of the College has remained the same throughout the course, consisting officially of only two, the Principal and Professor of Forestry and the Lecturer in Surveying and Engineering, under the administrative control of the President, Forest Research Institute and Colleges. Mr. Howard, whom we welcomed as our new Inspector-General of Forests at our last Convocation has been our President throughout the course. The College owes much to his able supervision and guidance of its affairs, and I should like to record my indebtedness and thanks to both Mr. and Mrs. Howard for their interest, advice and assistance in all matters connected with the College.

Mr. Harrison, the Lecturer in Surveying and Enginering, again assisted outside his normal duties by lecturing in Forest Law.

We have again to thank the various officers of the Forest Research Institute, who have been responsible for the lecturing, demonstrations and practical work in their respective subjects, namely:

In the *Botanical Branch*.—Dr. N. L. Bor, M.A., D.Sc., I.F.S., Forest Botanist, and his assistants Dr. K. D. Bagchee, D.Sc., and Mr. M. B. Raizada, M.Sc.

In the *Entomological Branch*.—Dr. C. F. C. Beeson, M.A., D.Sc., C.I.E., I.F.S., late Forest Entomologist and his assistant Dr. N. C. Chatterjee, D.Sc.

In the *Chemical Branch*.—Dr. S. Krishna, Ph.D., D.Sc., C.I.E., Biochemist, and the Soil Chemist Dr. R. S. Gupta, M.Sc., Ph.D.

In the *Utilization Branch*.—Mr. H. Trotter, I.F.S., Utilization Officer, and his various section officers; Mr. M. P. Bhargava, M.Sc., Paper Pulp Officer; Dr. K. A. Chowdhury, B.A., D.Sc., M.S., Wood Technologist; Mr. V. D. Limaye, B.E., Timber Testing Officer; Dr. D. Narayanamurti, M.Sc., Dr. Ing., Wood Preservation Officer; Mr. S. Ramaswami, M.A., Dip. For., Assistant Minor Forest Products Officer; Mr. M. A. Rehman, M.Sc., Wood Seasoning Officer; and Mr. Sultan Mohammad, Assistant Wood Workshop Officer.

In the *Silviculture Branch.*—Although they are not called on to conduct a definite part of the course, the Silviculturist Mr. A. L. Griffith, M.A., B.Sc., I.F.S., and his assistants Mr. T. V. Dent, B.Sc., I.F.S., Assistant Silviculturist; Mr. Jagdamba Prasad, B.Sc., LL.B., Experimental Assistant Silviculturist, and Forest Ranger S. P. Sahi, have given valuable assistance by occasional lectures, by help in the field work in the nursery and demonstration area, and in other ways.

In addition an outside lecturer, Dr. A. G. Jhingran, M.Sc., Ph.D., Geologist, was deputed by the Director, Geological Survey of India, to give a short course in Geology.

To all these officers the College again owes much for the excellent way in which they have conducted their parts of the course. Once again I should like to record our special thanks to Dr. Bor, who has again borne a considerably greater burden in this respect than any other officers.

The Lecturer in Surveying and Engineering has held concurrently the post of Timber Development Officer in the Forest Research Institute and since April, 1941, has also held the post of Lecturer in Engineering in the Indian Forest Ranger College. The internal administration of this College has, therefore, fallen entirely on the shoulders of the Principal. Considerable need for assistance has been felt, both at headquarters in the running of the College and the mess, and in the organization of games and other activities, and on the College tours. An assistant is also needed to relieve Dr. Bor of some of the lecturing in Botany, and to serve as a demonstrator in practical classes. It is hoped that this need will shortly be satisfied by the appointment of a second lecturer on the College staff.

The course has followed closely that adopted for the first class, the chief difference being the elimination of much of the Chemistry of minor forest products done in the first course and the allotment of more time to soil chemistry. The long list of officers who have assisted in the conduct of the course, as many in fact as the number of students, indicates the wide scope of the training. This is necessitated by the great variety of duties which confront the practical forest officer, and by the increasing dependence of Forestry upon allied sciences.

Included under "Forestry" proper, the study of Silviculture, Mensuration, Management, Valuation and Protection are of course essential for the principal duties of a forest officer, which involve not only the management and regeneration of good forests, so as to give the maximum sustained yield, but also the improvement of poor forests, of which there are vast areas in India, the prevention and amelioration of erosion, the management of grazing, the utilization of waste lands, and so on.

A sound knowledge of Forest Botany and Ecology is also essential. In the old days only a few valuable trees such as teak, *sal*, sandal, deodar and perhaps a dozen or so others were exploited and the forest officer could get on very well if he could identify these, lumping the rest together as miscellaneous or "junglewood" species, or *kokat*. Modern research has now shown that many of the trees considered valueless in the past are of great potential value, and the demand for them is steadily increasing, so that it is becoming increasingly necessary for the forest officer to know very many more of his trees, of which there are several thousands of species in the Indian forests.

The importance of an understanding of plant ecology in the application of Silviculture is being more and more acknowledged, and this again is dependent on a thorough knowledge of the systematic botany of the shrubs, herbs and grasses occurring in the forests as well as of the trees, and also of the broad principles of soil science. A knowledge of grasses is also essential for dealing with problems in the control and improvement of grazing. The students of this College are particularly fortunate in having as their principal instructor in Botany such an expert in systematic botany and on the grasses of India as Dr. Bor. His recent book on "The Common Grasses of the United Provinces" is a valuable addition not only to the books available for the use of the students, but to the botanical literature of India as a whole.

Under Botany also has again been included a short course in Pathology, dealing with the fungal diseases of trees and timber, and in general cryptogamic botany.

Surveying and Engineering are also important subjects occupying a prominent part in our course, since every forest officer must

be his own surveyor and engineer for the construction of roads, buildings, bridges and extraction works.

The importance of insect diseases and pests of trees, timber and other forest produce make these the chief subject of study under Forest Zoology. We are very grateful to Dr. Beeson for publishing his excellent and comprehensive book on "Forest Insects" just before he retired last year. The very size and comprehensiveness of the book indicates the vastness of the subject, and in this College we can only attempt to touch the fringe of it. Special emphasis is placed on the practical side of the subject, *i.e.* on an understanding of the methods of control and on the practical study of harmful insects in the field, including the collection of material and information required by the specialist, who must often rely upon the man on the spot for much of his data.

Utilization again is a very vast subject with which it is impossible to deal in great detail. Brief courses only can be given by the various research officers of the Forest Research Institute in such subjects as timber testing, seasoning and preservation, paper pulp and wood working. But more time is allotted to wood technology and the identification of the commoner Indian timbers, the qualities and uses of different timbers, and minor forest products, while saw-mills, timber passing and other aspects of the subject are studied on tour.

Finally, the course has again included the study of general Forest Law.

The practical work and the tours, which extend over all parts of India, have again occupied nearly one half of the available time. During the first year the class toured in the Himalayan forests of the Chakrata division in the United Provinces, the *sal* and miscellaneous forests of Kurseong and Buxa divisions in Bengal and of Gorakhpur, Haldwani, Ramnagar, Dehra Dun and Saharanpur divisions in the United Provinces, the irrigated plantations of Chhanga-Manga, and the erosion areas of the Pabbi Hills in the Punjab. The second year included a tour to the Kangra and Kulu forests in the Punjab, and an extensive tour to the evergreen, deciduous and dry forests of Coorg, Madras and Bombay. In Madras the Wynaad, Nilambur, Nilgiris, North Coimbatore, Madura and North Salem divisions were visited and in Bombay the three Kanara

divisions. On all tours special attention was paid not only to past and current practice, but also to experimental work under the provincial silviculturists, and in the United Provinces also to the village work under the Forest Development Officer.

Engineering, exploitation and utilization were also studied wherever possible. The Lecturer in Surveying and Engineering accompanied the class, together with the Principal, on the Kulu tour, for the study of roads, bridges and aerial ropeways. On other tours extraction by elephants, tramways, skidders and floating was seen and various forest saw-mills were visited. Large commercial saw-mills, railway carriage and wagon workshops, paper, *katha*, resin, bobbin and match factories, sandal depots, a small lac factory, and a cinchona plantation and quinine factory were visited at various places, and also the Mathematical Instrument Office, the Economic Botany gallery in the Indian Museum and the Botanical Gardens and Herbarium at Calcutta, and the new Mysore Forest Research Laboratory at Bangalore. On account of its occupation with war work, a visit could not be paid to the Forest Map Office at Dehra Dun, but the Officer in Charge very kindly lent glass and zinc plates and other material, demonstrating different stages in the process of map printing, for use in the lectures at the College.

Touring with its attendant transport problems, has become more difficult owing to the war, but in all cases our full programme has been carried out. For the success of the tours we are deeply indebted to the forest departments of all the Provinces visited and we should like to take this opportunity of again expressing our thanks and appreciation to the Chief Conservators and Conservators, and especially to the Divisional Forest Officers and their Forest Rangers and other officers who have assisted us in so many ways, to those other gentlemen who so generously gave us facilities for visiting their factories and mills, and to the railway administrations for their courtesy and help in providing facilities for our journeys.

Towards the end of the second year, a working plan was prepared by each student for part of the Dehra Dun forests. The area taken for this was specially selected to provide a wide range of forest types and as many problems of practical silviculture and forest management as possible. The month spent on this work formed a most valuable culmination to all preceding instruction.

The practical work has included nursery and plantation work at New Forest, weedings, cleanings and thinnings in various types of crops both at New Forest and on tour, felling of trees and stump and stem analysis, and the departmental burning of a felling area. As an exercise in road alignment the students laid out a short road in heavy grass land and hilly forest near Golatappar for the Divisional Forest Officer, Dehra Dun division. The class also attended an intensive course in practical field engineering at Roorkee with the King George V's Own Bengal Sappers and Miners. We are very grateful to the Commandant and the Superintendent of Instruction for arranging this course despite the great increase in their own training works for the war.

Our thanks are also again due to the Commandant of the Indian Military Academy for very kindly arranging a course in riding and another in rifle firing for the students of this College and to those members of his staff who gave up their time to conduct the courses.

The general health of the students has been very good and there has been a marked improvement in the general physique due to the daily games and to the strenuous exercise on tour. Due to making the Bengal tour earlier in the season and the Bombay tour later than previously, there has been very much less malaria among the students and servants than with the first class. The only serious illness has been one case of typhoid which kept a student in the Coronation Hospital, Dehra Dun, for nearly 7 weeks. One student accidentally had his left hand cut while doing practical thinning work in the Demonstration Area at New Forest, which necessitated the removal of his little finger and kept him in hospital for 5 weeks, while another student decided to develop chicken-pox for the third time in his life on the South Indian tour, and had to be left in hospital for 3 weeks at Ootacamund.

Games are compulsory for all students and the policy of requiring all students to practise all games was continued. Friendly matches have been arranged with local teams at New Forest and Dehra Dun, and the College has entered teams in the annual tournaments between the Indian Forest Ranger College, the Forest Research Institute and this College. In order to put these tournaments on a proper footing, running cups which can never be won

outright have now been provided for all these tournaments and for the joint athletic sports. For hockey we have the Mason-Jaspal cup, which was already in the possession of the Ranger College. For football, we are indebted to Dr. C. F. C. Beeson, for the presentation on his retirement of a cup to commemorate his 30 years' service in the Forest Research Institute as Forest Entomologist. The other cups have been provided jointly by the two Colleges and the Forest Research Institute.

With only 21 students to select from, it is not easy to put up strong teams and no cups have been won in the tournaments. The College has, however, put up a very good fight in all matches. We tied with the Indian Forest Ranger College in the last football tournament and only lost the cup in the last five minutes of a replay match. We congratulate our sister College on having won all the tournament cups and also the athletics cup this year.

In the combined athletic sports this year, the individual championship cup was won by M. A. Quadir of the Indian Forest Ranger College closely followed by G. S. Dhillon of this College, who as a Ranger College student won the cup on each of the two previous years.

Special attention is paid to tennis, which is probably the chief game that students will play after they have left the College. Interest in the game was greatly stimulated by the holding of several tournaments, notably one at the end of the first year for the Principal's cup for second court players, and handicap tournaments in the second year for cups kindly presented by Mr. Harrison for handicap singles and Mr. Howard for handicap doubles. The Open Championship Cup for tennis, presented by Mr. Owen Williams, our first Lecturer in Surveying and Engineering, was won by Y. M. L. Sharma of Mysore.

The importance of all these games and sports in fitting a man for the active life of a forest officer needs no further emphasis. But I may, perhaps, be permitted to emphasise the importance of Provinces and States selecting as their candidates men with an aptitude for games, as well as with high educational qualifications. Among students, proficiency in games is usually a good indication of physical fitness and is perhaps as valuable as, if not better than, a single physical test at the time of selection.

Among other activities of the College, the Science Society has held regular meetings during term time, when the students have contributed a number of interesting papers on a variety of subjects. We are very grateful to those officers and gentlemen who have helped us by coming to address the Society.

As has been mentioned, a students' technical library is not maintained, as they have the use of the Central Library of the Forest Research Institute. But a general common-room library is maintained. This was started in the first course by gifts of books from various officers. A further 130 books, mostly also gifts, have been added during the past two years. We are thankful to all those who have contributed books for this library, and shall be very grateful for any further gifts that anyone may be able to send us. We welcome books on general science, travel and exploration, biographies and other subjects as well as fiction.

An event of special interest has been the award to students of this College of part of the Currie Scholarship or prize. This scholarship originated in July, 1887, when on the occasion of the distribution of prizes at the Cooper's Hill College in England, Mr. B. W. Currie, who was then Vice-President of the Council of India, made a personal gift of £1,000 of 3½ per cent. India Stock in response to a plea by the President of the College for an increase in the number of scholarships available to its students. In 1906, when that College closed down, it was decided after consultation with Mr. L. Currie that the scholarship should be awarded to the probationer who headed the list at the final examination prior to appointment to the Indian Forest Service. Modifications of the scheme have been made consequent on the cessation of direct recruitment to the Indian Forest Service and on the separation of Burma from India. The scheme, as reorganized in 1940 under order of the Chancery Division of the High Court of Justice now provides that three-quarters of the net income shall be applied in the award of one or more annual prizes to candidates appointed to the Forest Services of India, and one-quarter in the award of prizes to candidates appointed to the Forest Services of Burma. So far as the Indian portion is concerned the Secretary of State for India has approved the award of the prizes to students of this College and has ordered that candidates trained for the Superior Forest Services of Indian States should

be regarded as eligible under the scheme, as well as candidates for the Provincial services.

As our course is biennial and no appointments were made by the Provincial governments to the forest services of India during 1939, the amount of the prizes for India for 1939 and 1940 was divided in the ratio of 60 and 40 per cent. between the students standing first and second in the 1938—40 class of this College. The awards made were, therefore:

1st Prize (£45—approximately Rs. 600) to Mohamad Habib Khan, B.Sc., Hons. Diploma I.F.C. (Kashmir State).

2nd Prize (£30—approximately Rs. 400) to Raghubir Chand Soni, M.A., B.Sc., Hons. Diploma I.F.C. (United Provinces).

Recommendation will now be made to the Secretary of State for India for the similar award of the 1941 and 1942 prizes to the two students standing first and second in the class now passing out.

Turning now to the results of the 1940-42 class, these are based not only on the results of first year and final examinations, but also on the record of the students during the whole of the course, marks being allotted for work on tours, for botanical and entomological collections, for plates drawn in Surveying and Engineering, and for general considerations, such as proficiency and keenness in games and sports, character and conduct and the demonstration of general qualities of leadership. As far as is possible with the technical nature of our curriculum, outside examiners conduct the examinations. These include officers entirely apart from the Forest Research Institute and Colleges and also officers of the Forest Research Institute staff other than those who have conducted the lecture courses; but in some subjects it has been necessary for the lecturers themselves to act as examiners. For the final examination this year we are indebted to Mr. D. Davis, Conservator of Forests, Working Plans and Research Circle, United Provinces, for acting as examiner in Forest Management, and to Mr. P. R. Duncan, Deputy Conservator of Forests (formerly Forest Engineer) for examining in Engineering. Mr. J. C. M. Gardner, who has succeeded Dr. C. F. C. Beeson as Forest Entomologist in the Forest Research Institute has examined in Forest Zoology, Mr. A. L. Griffith, Silviculturist, in Silviculture, and Mr. Gurdial Singh, Personal Assistant to the President, in

Forest Law. The other examiners were the various officers of the Forest Research Institute who have lectured to the College. To all these gentlemen we offer our thanks for their assistance in this somewhat onerous work.

Two diplomas are awarded by the College—the Honours and the Pass. The standard of the Honours Diploma is high. In the present class only one student has secured it, namely:

Kailash Chandra Jain, M.Sc., United Provinces.

Of the remaining students 19 have obtained the Pass Diploma:

(Here the list of students in order of merit, as given at the end of this report, was read out).

Four prizes are being awarded, namely:

The Hill Memorial Prize for Silviculture, won by Kailash Chandra Jain,

and three College prizes—

one for Botany, won by Kumud Nath Chaudhuri;

one for Engineering and Surveying, won by Kailash Chandra Jain,

and the last for the most practical forester, won by Amir Ahmad Khan.

In conclusion, may I add that we trust that the Diplomas about to be given to these students will not be regarded simply as certificates denoting a certain degree of theoretical knowledge. We have endeavoured to make the course as practical as possible while at the same time giving the necessary scientific basis essential to the making of a good forest officer, and we have laid stress on the application and not merely the acquisition of knowledge. We have also tried in various ways to prepare the students for the positions they are now being called on to take up in life, to instil a sense of professional integrity, devotion to duty and service, and to develop an *esprit-de-corps* that will transcend the barriers of provincial or state boundaries, and look to the welfare of India as a whole. The life on tours, the playing field, the common mess, the science society and the social relations with other officers of the Forest Research Institute and Colleges here have all played their part in this aspect of the training.

I think I can safely say that every student appreciates that he has far to go before he becomes a Forest Officer in the full sense of the words; and that he still has much to learn by service in and

close acquaintance with the forest. It now rests with the various Provinces and States receiving these students as their newly gazetted officers to see to their further training, to give them opportunity to acclimatize themselves to local forest conditions and to acquire that knowledge and wisdom that time alone can give.

The first few years of service are perhaps the most critical. A man's future may often be made or marred by the nature of the work he is first called on to do and by the type of officer under whom he is placed. We trust that these students passing out to-day will be fortunate in this respect; that they will be placed under the right type of officers who will look to their further training in the fullest sense of the world, who will not only assist them in the attainment of professional knowledge, but will guide them in the other directions that their calling and status demand, and who will help them to develop their personality, that they may worthily take up the torch from their predecessors and successfully run the race that is set before them."

The Principal then requested Mr. Ansorge to present the Diplomas and Prizes, after which Mr. Ansorge addressed the assembly as follows:

"Mr. President, Mr. Principal, Ladies and Gentlemen,

I greatly appreciate the honour the Indian Forest College has accorded me in inviting me to be present and distribute the prizes and diplomas at this Convocation and am grateful too for the opportunity that it gives me of meeting the students here—not only those who have completed their course and are now on the point of taking up in the Provinces and States of India the life's work which is before them, but also those who have gathered for the course which is now about to begin. I cannot pretend to speak with more than a superficial knowledge of the art of forestry which they are being called on to put into practice, but I have for some years past been closely associated with the forest policy of a certain province and can at least lay claim to a deep interest in the difficult but vitally important forest problems which call for a solution in this country.

The very interesting report of your Principal may have opened the eyes of some who were not before acquainted with the vast scope now covered by the simple word "Forestry". I should like to add

a word as to its vital importance to the peoples of India. To mention one aspect alone: the utilization of the natural manure cow dung for fuel purposes over so great a part of India, owing to the destruction of available forests, has provided a double-sided problem—how to find sufficient fuel and how to obtain essential manure—which continues to defeat all attempts to find a practicable solution. To mention another aspect, the terrible havoc wrought by the disastrous practice of "shifting cultivation", (*Taungya* cultivation or *Jhuming* or whatever its local name may be), not only in the destruction of the forest growth on the hills but in the consequent destruction of the fertile fields below by erosion of the soil, furnishes a problem the solution of which is essential to the welfare of those areas in which the practice continues unchecked. Research and experiment here have, I understand, demonstrated that under conditions of scientific control this destructive practice can be turned into a beneficent operation, but the methods to be adopted to harness the practice to this end and wean the aboriginal cultivator from his old way of life present a very difficult problem. The whole question of regulating the "Protected" (or as one might be justified in calling them the "neglected") forests is one that bristles with difficulties. Again, the problems of providing sufficient grazing for the cattle necessary for agricultural operations is in some areas very acute.

With these and a vast number of similar problems you gentlemen who have finished or are beginning this course will before long be confronted and your studies prosecuted here will have to be brought into practice. May I be permitted to lay stress on the importance of maintaining the closest possible touch and the utmost possible cordiality with the village population to whom your work will be of such importance and, I trust, of such lasting benefit? You will find throughout your service that a vast amount of beneficial work can be done by you with the co-operation of a friendly population which would be quite impossible if, through a misunderstanding of your motives or intentions, you were faced with the antagonism of the people among whom and for whom you are working. Your work will bring you into more continuous direct touch with the rural population than probably that of any other service in India, and the results you achieve will be conditioned not

only by your own enthusiasm and efficiency but perhaps to an even greater extent by your ability to win and maintain the confidence and good feeling of the villagers themselves.

Here in the Arcadian peace and beautiful surroundings of Dehra Dun, and even perhaps in the loneliness of the forests where your work will mainly be, you may sometimes, as Mr. Howard has said in his opening remarks, be tempted to feel that you are further than you should be at this moment from the mortal struggle which our countries are waging against the powers of darkness. The feeling is a natural one, but is none the less unjustified. This is a war not of men only, but above all of supplies and equipment, and the fullest possible use of all our resources is essential to victory. Among such resources the produce of our forests in India occupies a high and most important place, and everything each one of you can do to increase it and speed up its supply will bring the day of victory nearer. You are no doubt fully aware of the material contribution that has already been made by the research workers of this Institute to the successful prosecution of the war, and of the vast scope and variety of the supplies of timber and other forms of forest produce which have already been provided through the agency of the provincial and state forest departments for war purposes. Railway sleepers, timber for army huts, tent poles, synthetic glues, aircraft timber, medicinal drugs, cork substitutes, fuel oils—the list of articles is an unending one. It will be your business to continue and increase the flow of these supplies to the utmost of your ability. Every single piece of wood or other material supplied will be one more nail in the Enemy's coffin: Go forth then to your work, confident in the knowledge you have acquired at this College and determined to put it to the fullest possible use, sustained by the conviction that you are working for the salvation of your country and the lasting benefit of its people.

Mr. President, I thank you again for the honour you have paid me by inviting me here to-day and I wish all success to the College and its students during the course which is now about to begin."

A very memorable morning closed with three rousing cheers for Mr. Ansorge led by K. C. Jain, who had headed the list of students.

INDIAN FOREST COLLEGE

List of students of the 1940-42 class of the Indian Forest College awarded the Diploma of the College on their passing out on April 2nd, 1942

(In order of merit)

Honours Diploma—

1. Kailash Chandra Jain, M.Sc. ... United Provinces.
   Awarded—Hill Memorial Prize for Silviculture. College Prize for Engineering and Surveying.

Pass Diploma—

2. Mohan Lal Mehta, M.Sc. ... Kashmir.
3. Kumud Nath Chaudhuri, B.Sc. ... Bengal.
   Awarded—College Prize for Botany.
4. Amir Ahmad Khan, B.Sc. (Agric.) Punjab.
   Awarded—College Prize for the best all-round student and the most practical forester.
5. Gopal Chandra Dash, B.Sc. ... Orissa.
6. Y. M. Lakshminarayana Sharma, M.Sc. ... ... Mysore.
7. Ved Prakash Agarwala, M.Sc. ... United Provinces.
8. Shridhar Sadasheo Buit, M.Sc. ... Central Provinces.
9. Dinkar Hansraj Kulkarni, M.Sc. ... Central Provinces.
10. Gurbakhsh Singh Dhillon, M.Sc. ... Punjab.
11. Mohammad Ahsan Khan Khalil, M.Sc. ... ... United Provinces.
12. Mohammad Said, M.Sc. ... Punjab.
13. Krishna Chandra Roy Choudhury, B.Sc. ... ... Bengal.
14. Ghulam Naqushband, B.Sc. ... Kashmir.
15. Suresh Prasad Shahi, B.Sc. ... Bihar.
16. Rabindra Mohan Das, B.Sc. ... Assam.
17. Dharam Pal Singh, B.Sc. (Agric.). Punjab.
18. Gopal Singh, B.Sc. ... Balrampur Estate.
19. Kailash Narayana Mishra, B.Sc. ... Gwalior.
20. Mahabir Prasad Singh, B.Sc. ... Bihar.

TIMBER PRICE LIST, MAY-JUNE, 1942

(INDIAN STATES)

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Cochin ..	Logs ..	Re. 0-8-0 per c.ft.
"	"	Travancore..	Logs ..	Re. 0-11-0 per c.ft.
Benteak ..	*Lagerstrœmia lanceolata*	Cochin ..	Logs ..	Re. 0-12-11 to 1-4-4 per c.ft.
" ..	" ..	Mysore ..	Logs ..	
"	"	Travancore..	Logs ..	Rs. 1-4-10 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Barwani ..	Logs ..	Re. 0-12-0 per c.ft.
"	" ..	Cochin ..	Logs ..	Re. 1-1-6 to 1-7-5 per c.ft.
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Holkar ..	Beams 14′×18″	Rs. 2-0-0 per c.ft.
" ..	" ..	Hyderabad..	Logs ..	Re. 0-8-0 to 1-8-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore..	Logs ..	Rs. 1-10-9 per c.ft.
Deodar ..	*Cedrus deodara* ..	Patiala ..	Sleepers 10′×10″×5″	Rs. 7-4-0 each.
Dhupa ..	*Vateria indica* ..	Cochin ..	Logs ..	Re. 0-12-11 per c.ft.
Gamari ..	*Gmelina arborea* ..	Tripura ..	Logs ..	Re. 1-0-0 to 1-12-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Cochin ..	Logs ..	Re. 0-14-9 to 1-9-11 per c.ft.
" ..	" ..	Tripura ..	Logs ..	Re. 0-8-0 to 1-4-0 per c.ft.
Haldu ..	*Adina cordifolia* ..	Bansda ..	Logs ..	
" ..	" ..	Banswara ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	
" ..	" ..	Cochin ..	Logs ..	
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Mysore ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore..	Logs ..	Re. 0-13-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Cochin ..	Logs ..	
" ..	" ..	Travancore..	Logs ..	Rs. 1-7-9 per c.ft.
Indian Rosewood..	*Dalbergia latifolia* ..	Bansda ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 1-0-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 1-8-7 to 2-13-3 per c.ft.
" ..	" ..	Dhar ..	Logs ..	
" ..	" ..	Kishengarh	Logs ..	
" ..	" ..	Mysore ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore..	Logs ..	Rs. 1-1-2 to 2-2-10 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul	*Xylia xylocarpa*	Cochin	Logs	Re. 0-7-5 to 1-8-7 per c.ft.
,,	,,	Travancore	Logs	Rs. 1-3-6 per c.ft.
Kindal	*Terminalia paniculata*	Cochin	Logs	Re. 0-13-10 to 1-3-8 per c.ft.
,,	,,	Mysore	Logs	
,,	,,	Travancore	Logs	Rs. 1-3-11 per c.ft.
Laurel	*Terminalia tomentosa*	Bansda	Logs & squares	
,,	,,	Barwani	Logs	Re. 0-10-0 per c.ft.
,,	,,	Bhopal	Logs	
,,	,,	Cochin	Logs	Re. 0-12-11 to 1-6-2 per c.ft.
,,	,,	Holkar	Sawn material	
,,	,,	Hyderabad	Logs	Re. 0-6-0 to 1-8-0 per c.ft
,,	,,	Mysore	Logs	
,,	,,	Patna	Logs	
,,	,,	Travancore	Logs	Rs. 1-11-1 per c.ft.
Mesua	*Mesua ferrea*	Cochin		
,,	,,	Tripura	Logs	Rs. 1-8-0 to 1-12-0 per c.ft.
Sal	*Shorea robusta*	Cooch Behar	Logs & scantlings	
,,	,,	Patna	Logs	
,,	,,	Tripura	Logs	Re. 1-0-0 to 1-8-0 per c.ft.
Sandan	*Ougeinia dalbergioides*	Bansda	Logs	
,,	,,	Patna	Logs	
Semul	*Bombax malabaricum*	Banswara		
,,	,,	Cochin	Logs	Re. 0-8-0 per c.ft.
,,	,,	Cooch Behar	Logs & scantlings	
,,	,,	Rampur	Planks 6′×1′×1¼″	
,,	,,	Travancore	Logs	Re. 0-11-0 per c.ft.
,,	,,	Tripura	Logs	Re. 0-4-0 to 0-8-0 per c.ft.
Sissoo	*Dalbergia sissoo*	Banswara		
,,	,,	Cooch Behar	Logs & scantlings	
,,	,,	Hyderabad	Logs	
,,	,,	Rampur	Planks 6′×1′×1¼″	
Teak	*Tectona grandis*	Bansda	Logs	
,,	,,	Banswara	Logs	
,,	,,	Barwani	Logs	Re. 0-12-0 to 1-8-0 per c.ft.
,,	,,	Bhopal	Logs	
,,	,,	Cochin	Logs	Rs. 1-8-7 to 3-1-3 per c.ft.
,,	,,	Holkar	Sawn material	Rs. 2-8-0 per c.ft.
,,	,,	Mysore	Logs	
,,	,,	Travancore	Logs	Re. 0-15-1 to 2-2-0 per c.ft.

EXTRACTS

VERNALIZATION

By S. R. Barooah, B.Sc. (Ag.),

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The most remarkable achievement in agriculture during recent years has been the Russian discovery that by suitable treatment of seeds before sowing, crop production can be greatly hastened. Professor T. D. Lysenko of the Odessa Institute of Plant Breeding discovered the process in about 1928 and called this method "jarovizacii" in Russian, though it is now more widely known by its Latinite form "Vernalization". With the extension of cultivation to the Arctic regions where it has hitherto been a hazardous task, the cultivation of spring wheats in the semi-arid zone of the Ukrainian steppes where high temperatures damage the crops just prior to heading, the possibility of growing more than one generation of plants within the same year and the general improvement in yield and in quality are amongst others a few of its accomplishments.

The main principles behind the Lysenko's theory of vernalization is that in the life of a plant there are a series of separate stages which always proceed in strict sequence and a subsequent stage cannot set in until the preceding stage has been completed. The separate stages require different conditions for their completion, the important stages being "thermo-stage" and "photo-stage". In the thermo-stage the temperature is the main factor: if this is not supplied then the plants will not develop. The next stage is called the photo-stage because the governing factor here is the length of illumination per day, and the temperature variations do not, matter very much. Completion of the photo-stage requires first the completion of the thermo-stage and then the appropriate length of illumination, the intensity of light being of no consequence. If these two stages are fulfilled then the plants will produce seeds, otherwise not. On this principle the practice of Lysenko's vernalization is based. The theory is now corroborated by almost all the workers on this line, though some of them have offered certain modifications to this theory. Thus vernalization—the treatment of seeds before

sowing—must have completed these two stages before they are said to be vernalized.

Gassner in 1918 showed that if the germinating seeds of winter cereals be kept at a temperature near freezing-point for about a month and then sown, the plants mature early. This method as such is quite impracticable for cultivators' purposes as the seedlings become too large to be handled. Lysenko hit upon the idea of retarding their growth by limiting the supply of water. The seeds then remain fit to be sown in the usual way and can even be dried and stored for a time. The precise method of vernalization varies with different plants and also with different varieties of the same plant. To be successful in this act it is necessary to determine the exact condition of each form. Winter wheats are vernalized by first soaking in water, but the weight of the absorbed water should not be more than 50 per cent. of the dry weight of the seed. The seeds are kept in this water for one or two days at room temperature when they get swollen and the embryos begin to emerge from the seed coat. They are then kept in darkness at a temperature of 35-36° F (near freezing-point) for 40 to 50 days. After this period the process of vernalization is complete and the seeds are ready for sowing. The best results are obtained if the seeds are sown immediately after vernalization and therefore treatment should be started at such dates that the vernalization is finished on the day of sowing. If absolutely necessary, vernalized seeds may be dried for storage by adding about 30 per cent. more dried seeds of the same variety, but in no case should they be kept for more than fifteen days before sowing.

The vernalized seeds are outwardly quite similar to the unvernalized ones, but differ qualitatively from the latter. The precise nature of this qualitative change is not known. One school of thought says that it is due to the enzyme, while another school believes that hormones are the causal agents. But there is no doubt that a change of the colloidal and chemical nature of the protoplasm takes place during vernalization as it is proved by the fact that the vernalized and unvernalized seeds react differently to certain stains. Thus, it is only with stains that a seed can be detected whether or not it is vernalized.

The method is widely practised in Russia. By this process winter cereals can be made to yield if sown in spring. And in the case of the spring varieties the great hastening of seed formation makes it possible to obtain two crops in the same season. It has also made it possible to grow high-yielding late varieties in dry regions like the Ukraine where they are usually destroyed by heat and drought. Due to the great hastening of crop production by vernalization succesful cultivation even in Arctic regions is now made possible, where very little agriculture was prevalent due to heavy snow. The yields from the vernalized plants are also much greater. At Odessa it has been found that in two varieties of wheat imported from outside the yield is 25 per cent. more when vernalized, and also it is much more than the best local variety grown normally. Not only yield but other qualities such as drought resistance, size, quality and weight of the grains are also increased as shown by the results obtained with all the varieties of wheat collected all over the world. Milling and baking qualities are also much improved. Soya beans cultivation has been impracticable in Germany and England due to the long days prevalent when the plant grows. After vernalization they grow very well in the summer and there is no need to grow them in warm green houses during the short days of winter. Results with other crops had been equally encouraging. In oats the increase in yields was 22 per cent. Rice in Holland showed earlier tillering (branching at the base) and the yields were 18 and 14 per cent. more in the case of grain and straw, respectively. Potatoes in the central Volga region made the crop mature one month earlier, and the yield was 10 per cent. more than usual. To plant breeders vernalization has been an invaluable asset, they can obtain even three generations of winter wheat and four of spring variety in one year by vernalization combined with artificial control of the length of day. But not much work seems to have been done to test the ability of the vernalized plants to resist diseases. However, marvellous results have been achieved in other respects by the use of this method, in foreign countries.

While results obtained in Russia are so striking they are less encouraging in other countries under different climatic conditions or with other crops. In India the results so far have not been

promising. At Pusa two varieties of wheat and barley were vernalized and sown. With wheat there was not much change; but barley, when vernalized for one week, showed accelerated maturity of one to six days. Cotton and Sorghum when vernalized in Nagpur did not show definite results but in some cases the latter showed an acceleration of 3 to 4 days in maturity. Against the failures from different places it will be interesting to note the results recently published from the Vivekananda Laboratory, Almora, by B. Sen and S. C. Chakravarty. They have obtained good results with mustard.

Vernalization was not widely practised in Russia till 1932 when the area under vernalized crops was about 86,000 acres. In 1933 it rose to about 400,000 acres, and in 1934 the figure reached to about 2 million acres. Unfortunately, not many attempts have been made in India and positive results have not been obtained. A suitable technique of vernalization for a particular crop is beset with considerable difficulties and to this is added our ignorance of the developmental features of tropical plants and of the environmental factors influencing them. These two reasons together would account to a great extent the failure of experiments made in India.

One of the chief difficulties of the agriculturists in India is to fight against the uncertainties of weather conditions. Excessive rains or high temperatures often do not permit crop to stand in the field for a long time. Raids of frequent floods in the fertile lands of India are too well known. Under these adverse conditions of agriculture it will be a great boon to the agriculturists if the crops could be harvested in a very short time during which unfavourable weather conditions might not set in. Some of the difficulties in agriculture could certainly be overcome by the method of vernalization. Hence it is very desirable that some workers having developed a suitable technique should take up the problem of vernalization of crops like rice, wheat, cotton, jute and others, which have successfully been vernalized by workers outside India. Let us hope for a better prospect of vernalization in India.—*The Allahabad Farmer*, Vol. XV, No. 5, dated September, 1941.

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FLOWERING AND FRUITING OF FOREST TREES OF CEYLON—I

BY C. H. HOLMES

Abstract.—This note refers to previous attempts made with the object of collecting reasonably dependable information on the mass flowering and fruiting of Ceylon trees and describes the procedure by which information now given has been collected and analysed. The irregularities in times of fruiting in relation to external climatic conditions exhibited by a large number of species are discussed. It is suggested that there is no real necessity to attempt to find any definite parallelism between climatic seasons and periods of flowering and fruiting in the Tropics nor to "explain" apparent irregularities on the assumption that the periodicity evident at present was determined earlier in the history of species so concerned by different climatic conditions than happen to obtain now. The chances are that periodicity of flowering and fruiting is not determined at any time by climatic variations alone and it would appear that a large number of different factors are probably responsible, the nett resultant effects of which actually make possible the adequate perpetuation of a species despite apparent anomolousness of its behaviour as regards times of flowering and fruiting in relation to observed climatic variations.

Brief notes are given on the "Distribution" and times of flowering and fruiting of 31 different species checked up against actual times of collections of flowering material for herbarium specimens and of seed for other experimental purposes. A tabulated statement summarising briefly the information on all species dealt with is appended for easy reference.

The need for definite knowledge of the periodicity of flowering and fruiting of the principal economic tree species has long been felt and various attempts have been made from time to time to collect this information. Earlier attempts have been merely to

call up reports from territorial divisional forest officers and subordinate field staff by circular letters, when special interest in one or other species happened to be roused and to compile general information on each such species from the mass of opinions on matters of silvicultural or quasi-silvicultural interest including phenological aspects expressed by recipients of these letters. Naturally, opinions varied widely and in the absence of any means of checking up divergent views immediately it was not infrequently impossible to come to conclusions. In 1933 a more definite attempt was made by requiring range and divisional forest officers to keep registers of silvicultural information for different species separately including notes on flowering and fruiting on special stereotyped forms supplied to them. It was intended, of course, that officers keeping these records should enter up their forms from direct field observations. In practice preoccupation with their ordinary multifarious routine duties precluded for most officers the possibility of keeping constant notes with the result that registers were generally left over till called for and then perforce had to be hurriedly filled up for submission. Once again information gathered by this means was no more than expressions of individual opinion and did little or nothing to help amassing objective information based on actual observations. Finally in 1936 the method of collecting information on flowering and fruiting by statements attached to weekly diaries of foresters, forest rangers, range assistants and overseers was introduced.

Stereotyped forms distributed for the purpose required: dates of observations; local and botanical names of species recorded: whether flowering or fruiting; and remarks on condition of flowers and fruits. The territorial divisional forest officers collected the weekly statements and forwarded them to the head office where they were examined, sorted out to species and entered up in registers. Whenever there was reason to doubt the accuracy of any of the recorded observations as regards identity of a species or correctness of observation, such dubious reports were referred back for verification by submission of herbarium specimens or collection of seed and records concerned were amended or discarded as found necessary. This procedure was continued from commencement at the end of 1936 to the end of 1940—a period of four

years. During this time information on some 150 different species was collected. A careful examination of the registers, in which information gathered had been entered up under each species, revealed that a considerable mass of evidence on 30 to 40 important tree species as would justify detailed study had accumulated. After further consideration it was concluded that the system followed was unlikely to yield much more information of value if continued over a longer period. It was decided, therefore, to see what could be done with the information in hand and for the future to continue the study—for amplification of data already gathered and for fresh information on species other than those on which sufficient knowledge had already been gained—by observations on numbered and identified trees in linear phenological observation plots selected for the purpose.

Of the species on which adequate information was available those of doubtful specificity—*e.g.* where local names were not monospecific or species liable to be confused with others—were omitted and the data collected on the rest were analysed. This was done by grouping reports on flowering and fruiting of each species separately into convenient geographical centres of their distribution—chiefly range stations. The observations were then sorted into calendar months under each separate year of the period of observations for each centre separately. Against each month of each year was entered up the total number of observations per centre for that month and the number of different observers responsible for them. Owing to transfers reports from individual range stations were not all from the same set of observers but from different people at different times. For this reason and the lapse of time involved, reports for the same months of different years were treated as coming from different and independent observers when the data was finally summarised for the total period of observations and for all stations in respect of each species. In the case of reports on fruiting these figures were further qualified by taking note of the number of times for each month of the year at each centre "ripe" or "falling fruit" or "seed" had been specially noted. The final summary of the data for milla (*Vitex pinnata*) and palu (*Manilkara hexandra*) given below will serve to illustrate the method of analysis followed:

VITEX

(*Note : The first figure gives total number of*

Months.	Ratnapura	Elpitiya	Matugama	Waga and Avissa-wella	Kegalle—Kandy	Galle—Matara
						STAT
						FLOW
January ..	2—2	1—1	..	3—2	..	..
February ..	7—2	..	1—1	..	..	1—1
March ..	3—2	..	..	..	..	..
April ..	10—3	..	1—1	..	..	..
May ..	12—3	5—3	3—3	..	..	3—1
June ..	21—3	2—2	6—3	6—5	5—5	13—4
July ..	15—3	8—4	4—3	3—2	..	14—4
August ..	24—3	12—4	1—1	1—1	2—1	15—7
September ..	21—6	3—2	..	1—1	..	6—3
October ..	27—12	5—5	1—1	..	1—1	2—2
November ..	8—5	1—1	..	2—2	..	..
December ..	1—1	3—3	..	..	..	..
						FRUI
January ..	..	..	..	..	..	..
February ..	..	..	..	..	..	1—1
March ..	1—1	..	..	..	..	..
April ..	..	..	..	..	..	..
May ..	..	..	..	..	..	..
June ..	..	1—1	..	..	..	..
July ..	..	2—2R[1]	..	..	..	..
August ..	6—1	2—1	2—2R[1]	..	..	1—1
September ..	13—7R[2]	6—4	2—1	..	..	9—4R[5]
October ..	18—7R[2]	6—5	2—1	..	..	16—7R[2]
November ..	4—3R[3]	3—2	..	1—1	..	3—3
December ..	2—2	1—1	..	..	..	1—1

PINNATA, L.

observations and the second number of observers.)

IONS

	Kurunegala	Chilaw—Dandegamuwa	Kilinochchi-Vavuniya	Trinco—Batticaloa	A'pura—Kekirawa	Puttalam	Total
ERING							
	2—2	..	5—4	2 1	7—5	..	22—17
	5—4	..	5—4	6 -3	7—2	2—2	34—19
	3—2	..	2—1	7—3	..	..	15—8
	4—3	..	..	..	..	..	15—7
	2—2	2—2	..	..	..	..	24—11
	12—10	4—4	7—5	3—2	1—1	1—1	83—42
	15 -11	2—2	17—7	27—7	2—2	I—1	118—42
	14—8	3—2	7—5	21—5	1—1	..	91—38
	3—3	5—4	2—2	8—3	8—7	1 -1	59—32
	11—9	3—3	2—2	2—1	4—3	..	58—39
	6—4	..	3—3	7—2	8 5	..	35—22
	2—2	..	1—1	5—2	3—2	1—1	16—12
TING							
	..	..	4—2	4 -1	3—3R^{1}	2—2	13—8R^{1}
	..	..	7—5	3—1	1—1	5—1	17—9
	1—1	..	1—1	6—1	1—1	3—1	13—6
	..	..	1—1	2—1	2—2	..	5—3
	..	..	4—1	2—1	1—1	..	7—3
	2—2	..	1—1	1—1	..	..	5—5
	2 -2	1—1	..	..	..	..	5—5R^{1}
	7—4R^{1}	1—1	5—2	7—2	..	..	31—14R^{2}
	2—2	5—4R^{3}	2—2	4—2	2—2	..	45—28R^{10}
	9—7R^{3}	2—2R^{2}	5—4R^{2}	13—4R^{1}	4—4	..	73—41R^{7}
	..	3—3R^{2}	3—2R^{2}	12—3R^{1}	4—2	3—1	35—19R^{8}
	1—1	..	8—5R^{1}	5—2	3—2	1—1	22—15R^{1}

MANILKARA HEXANDRA,

(Note : The first figure gives total number of observations

Months	STAT			
	Trincomalie	Batticaloa	Jaffna	Vavuniya
				FLOW
January ..	9—3	..	6—5	3—2
February ..	19—3	..	8—6	8—3
March ..	10—2	..	11—5	9—2
April ..	..	..	5—2	1—1
May ..	..	..	..	..
June ..	..	..	..	..
July ..	..	..	..	..
August ..	..	..	..	..
September ..	..	..	..	..
October ..	..	..	..	..
November ..	..	..	..	..
December ..	5—1	..	..	..
				FRUIT
January ..	3—1	..	..	1—1
February ..	12—2	..	..	..
March ..	17—3	..	1—1	1—1
April ..	24—4	..	1—1	9—2
May ..	22—4	1—1	16—10	6—3
June ..	21—4R[2]	1—1	18—8R[3]	13—5
July ..	..	3—1	16—6R[2]	9—4R[1]
August ..	..	..	2—2R[2]	5—2R[2]
September ..	..	..	..	..
October ..	..	..	..	..
November ..	..	..	..	..
December ..	..	..	..	..

Dubard.

and the second the number of observers).

I O N S.

Anuradhapura	Puttalam	Kekirawa	Kurunegala (Mabo)	Total
ERING.				
3—1	..	1—1	..	22—14
12—4	3—2	2—2	2—2	54—22
6—4	2—2	3—2	..	41—17
..	..	..	..	6—3
..	..	..	..	..
..	..	..	..	..
..	..	..	1—1	1—1
..	..	..	..	..
..	..	..	..	..
..	..	1—1	1—1	2—2
1—1	..	..	..	1—1
..	..	1—1	..	6—2
ING.				
..	..	..	..	4—2
..	..	..	..	12—2
4—3	..	1—1	..	24—9
6—2	1—1	2—1	..	43—11
13—6	1—1R[1]	1—1	11—7	71—33R[1]
11—5	2—2R[1]	2—1R[1]	8—5	76—31R[5]
5—3	2—1	..	10—7R[3]	45—22R[8]
..	..	..	2—2	9—6R[4]
..	..	..	..	..
..	..	..	2—2	2—2
1—1	..	..	..	1—1
..	..	..	..	..

The total number of species on which it is considered reasonably definite and dependable information has been collected amounts to 31, representing 15 different families and include species of all the principal climatic and vegetational zones of the Island excepting the, sub-tropical wet evergreen forests of the hill-country. The conclusions arrived at have been checked with dates of collection of herbarium specimens, where available, for flowering. As regards fruiting, except in respect of a very few species, conclusions have been compared with the independent evidence of actual collections of seed for use in experimental nurseries and gardens. It will be noted with satisfaction that this evidence substantially confirms the information gleaned from occular observations alone.

Unlike in temperate climes anything like mass flowering of spring-time cannot obviously be expected in the Tropics. Yet it is true that the hot dry weather in the early part of the year often occasions in Ceylon a kind of pseudo-spring flowering of a large number of different tree species. This is, however, not strictly comparable with the phenomenon so familiar in the Temperate Zone and there is no well-defined season of general flowering and consequently neither of fruiting.

Excluding such rather exceptional cases of cyclic flowering and fruiting exhibited by certain species, *e.g.* bamboos and *Strobilanthes* lowly shrubs, herbs and grasses generally flower and fruit several times or continuously throughout the year. In contrast to this the more highly developed trees do not as a rule go through these sexual functions more than once a year and do in the majority of cases exhibit a definite periodicity.

"A priori", we would expect to find this periodicity linked up with and determined by such climatic differences as are experienced during the year in any locality. Though a number of species actually do conform to expectations and flower and fruit in what may justifiably be reckoned as seasonable times in the climatic zones of their occurrence, a considerable number of other species do not. For example of the 31 species dealt with in this paper only 3 species of the wet zone (viz: *hora**, *del* and *iriya*) and 7 of the dry zone (viz: *satin, kohomba, madan, mi, ebony, kumbuk* and *godakaduru*) are found to fruit in about right time for the south-west and north-east monsoonal periods which are the principal rainy seasons in each zone respectively. On the other hand there are an almost equal number of species which though confined chiefly to either the dry or the wet zone still fruit when external weather condi-

**Hora* (*Dipterocarpus zeylanicus*, Thw.); *del* (*Artocarpus nobilis*, Thw.); *iriya* *Horsfeildia iriya*, Gaertn.); *kohomba* (*Azadirachta indica*, A. Juss.); *madan* (*Syzygium cumini*, Skeels.); *mi* (*Madhuca longifolia*, Macbr.); *kumbuk* (*Terminalia arjuna*, W. & A.); *godakaduru* (*Strychnos Nux-vomica*, L.).

tions are normally apparently wholly or partially unsuitable. The following dry zone species, for instance, ripen fruit in comparatively dry weather several months before the principal rains of the north-east monsoon are due: *kirikon**, *dikwenna, kon, ratu-wa,* tamarind, *vel-vel, ranai, palu* and *wira;* and in the following wet zone species fruits ripen and fall just before or with the commencement of the north-east instead of as may be expected the south-west rains: *hal* and *maruta.*

There is a tendency for certain species of wide geographical and climatic distribution to shew widespread or extended periods of flowering and fruiting, *e.g.*, (*a*) *godapara, diyapara* and *kekuna,* —generally found in the wet and intermediate zones of the Island; (*b*) *halmilla* and *wa* of the dry and intermediate zones; and (*c*) *milla* and *lunumidella* of the wet, intermediate and dry zones. In the case of *etamba* which is also common to the three principal climatic zones mentioned, there is a suspicion that the flowering and fruiting is somewhat adjusted to local climatic conditions prevailing in the dry as compared with the wet and intermediate zones though the data are not yet sufficiently conclusive. On the other hand there are a number of species equally widely distributed which yet have restricted and well defined seasons of flowering and fruiting. These periods remain the same no matter in which particular zone *e.g.*: (*a*) *del* and *iriya* of the wet and intermediate zones; (*b*) *kon, katuimbul* and *ehela* of the dry and intermediate zones; (*c*) *kumbuk* of the dry, intermediate and wet zones.

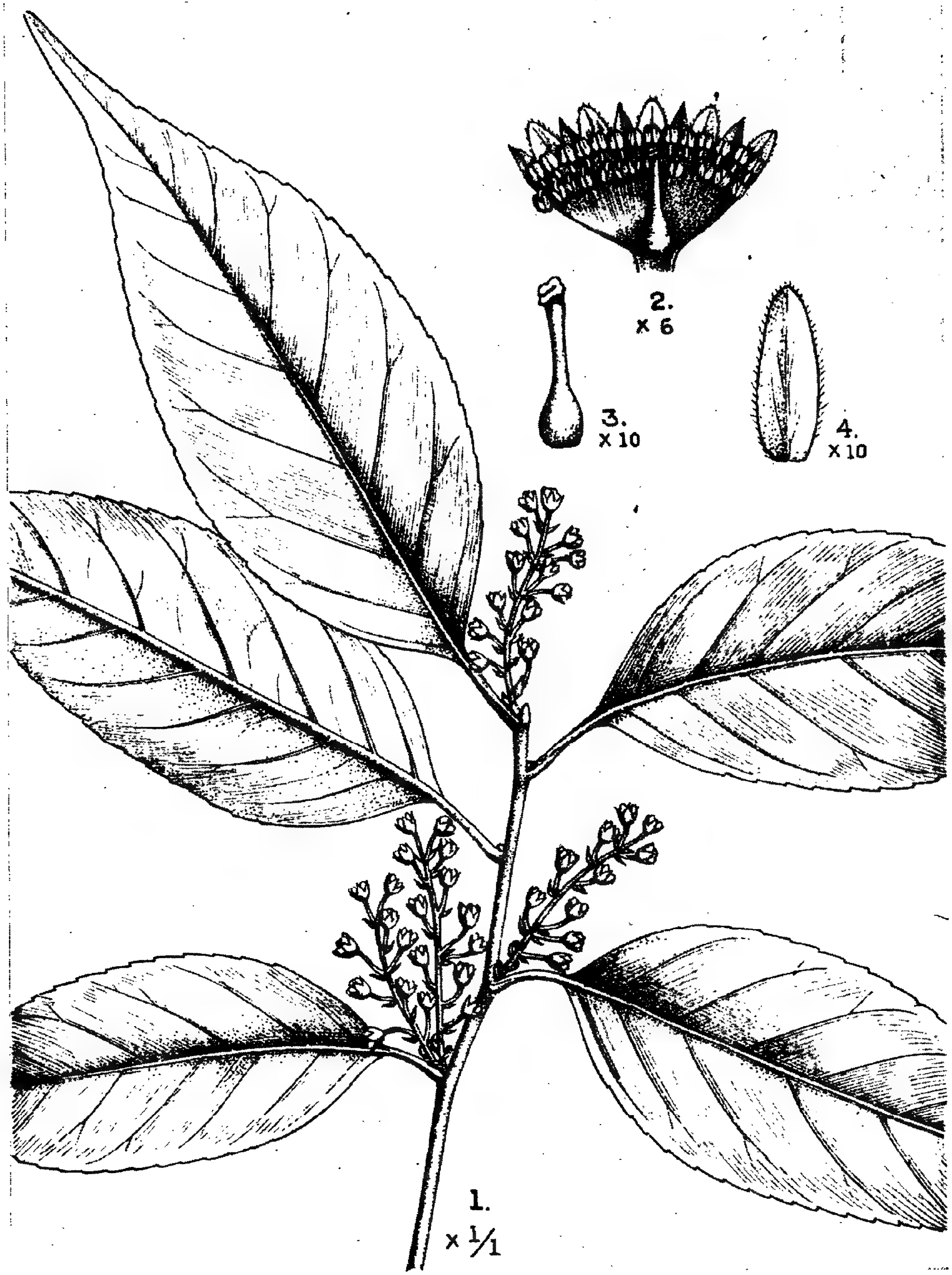
Though there would appear, therefore, to be some correlation beteween climate and the functions of flowering and fruiting in certain species or types of species—others are equally independent of the climatic conditions obtaining in the localities of their occurrence. The obvious conclusion is, of course, that climatic conditions alone are not responsible for determining times of flowering and fruiting—at least not in all cases. It is quite conceivable that

**Kirik* (*Walsura piscidia,* Roxb.); *dikwenna* (*Pityranthe veraucosa.* Thw.); *kon* (*Schliecera oleosa,* Merr.); *ratu-wa* (*Cassia marginata,* Roxb.); *vel-vel* (*Acacia leucophloea,* Willd.); *ranai* (*Alseodaphne semecarpifolia,* Nees.); *palu* (*Manilkara hexandra,* Dubard.); *Wira* (*Hemicyclia sepiaria,* W. & A.); *godapara* (*Dillenia retusa,* Thumb.); *diyapara* (*Wormia triquetara,* Roxb.); *kekuna* (*Canarium zeylanicum,* Bl.); *halmilla* (*Berrya cordifolia,* Burret.); *wa* (*Cassia siamea,* Lam.); *milla* (*Vitex pinnata,* L.); *lunumidella* (*Melia composita,* Willd.); *et mba* (*Mangifera zeylanica,* Hk. f.); *katuimbul* (*Gossampinus malabarica,* D. C.); *ehela* (*Cassia pistula,* L.).

even in the case of those species the periodicity of the flowering and fruiting of which conforms nicely to climatic variations, these variations are not always the actual determinants though they appear to be so. Once it has to be admitted that factors other than that of climatic variation are responsible it becomes open to question whether it is not pure assumption prompted by what seems probable that climatic conditions are actually responsible even in those cases where flowering and fruiting harmonize with them. Similarly, any hypothesis which would try to explain apparent irregularities of flowering and fruiting in relation to present climatic conditions as being due to the continuance unchanged of characteristics acquired during earlier periods, when such conditions were different, will also be subject to the same objection.

Any seasonal periodicity shown by a species may be genotypic without it having been acquired through influence of any particular set of environmental conditions. Though such characteristics may in some cases be purely phenotypic and determined by environmental conditions as when there is variation of the time of flowering and fruiting brought about by changes of location or climatic conditions. There is no reason to suppose that in each and every case the times these functions of plant life should take place must be determined directly by outside influences. If the times of flowering and fruiting, however restricted or definite, of a certain species were, for the sake of argument, entirely fortuitous the persistence of that species, despite any advantages obvious or apparent, real or assumed these times may involve, would mean merely that such disadvantage has been effectively overcome by other less apparent advantages which help to secure the perpetuation of that species. The cases of fruiting at times just preceding the onset of the north-east monsoon either in the wet or intermediate zones constitute no serious disadvantage to seedlings in view of there being a considerable rainy period to follow. It may even be distinctly beneficial that seeding should take place at this rather than prior to the principal rains of the south-west monsoon for the reason that the north-east rains are generally lighter and better distributed than the heavy downpours characteristic of the south-west monsoon rains.

(To be continued.)



Ganga Singh

PYGEUM MOONEYI M. B. RAIZADA SP. NOV.

1. A twig with leaves and inflorescence.
2. A flower opened up.
3. A carpel.
4. A petal.

A NEW PYGEUM FROM BASTAR STATE, ORISSA

By M. B. Raizada, M.Sc.,

Assistant Forest Botanist, Forest Research Institute, Dehra Dun

Pygeum mooneyi Raizada sp. nov. (Rosaceae-Pruneae); haec species P. andersoni Hook f. similis est, sed ab eo calyce obtonico, calycis lobis triangularibus (haud late-ovatis, obtusis, ciliatis), calycis lobis aequilongis petalis, et plerumque 26 staminibus (haud 15) valde differt.

A small evergreen tree up to 100 m. high and 1 m. in girth (Mooney). Leaves alternate, exstipulate, oblong-lanceolate, acuminate, faintly serrulate, upto 15 cm. long and 5 cm. wide, dark green above, pale beneath, glabrous on both surfaces; medium nerve channelled above, raised on the lower surface; petiole upto 15 mm. long, stout, channelled above. Flowers small, white, in rather stout, glabrous, axillary racemes 2—4.5 cm. long (elongating in fruit ?). Bracts concave, scarious. Bracteoles 2, minute. Pedicels short, upto 5 mm. long. Calyx obconic with 5 triangular lobes, imbricate in bud, glabrous, lobes 2 mm. long, acute at the tip. Petals 5, oblong, scarcely longer than the calyx lobes, rounded at the tip, faintly and softly tomentose on the margins. Stamens 20—26, usually 26, in one series with stout filaments, (some stamens incurved), nearly included; anthers 4-celled, basifixed. Ovary superior, glabrous, 1-celled; ovules two, style simple, stout, persistent in fruit (?); stigma obscurely 4 (?)-lobed. Mature drupe not seen.

Bastar State, Bailadila Hill, 3,400 ft., in damp ravine behind bungalow, Jan. 1941, Ahmed Ali per H. F. Mooney 1551 a (Holotypus in Herb. Dehra).

Other collections seen are H. F. Mooney 1551 and 904.

This species is related to Pygeum andersoni HK.f. but differs from it chiefly by the calyx being obconic, by the triangular lobes of the calyx (not broadly ovate, obtuse, ciliate), by the petals being equal to the calyx-lobes and by the presence of usually 26 stamens (not 15).

This species is named in honour of its discoverer, Mr. H. F. Mooney, I.F.S., Forest Adviser, Eastern States, who has made several interesting additions to the flora of Bihar and Orissa.

STUDIES IN CLIMATIC CHANGE—I

AMELIORATION, BY CONTOUR TRENCHING ARID HILL FOREST SLOPES

BY W. D. M. WARREN, I.F.S.

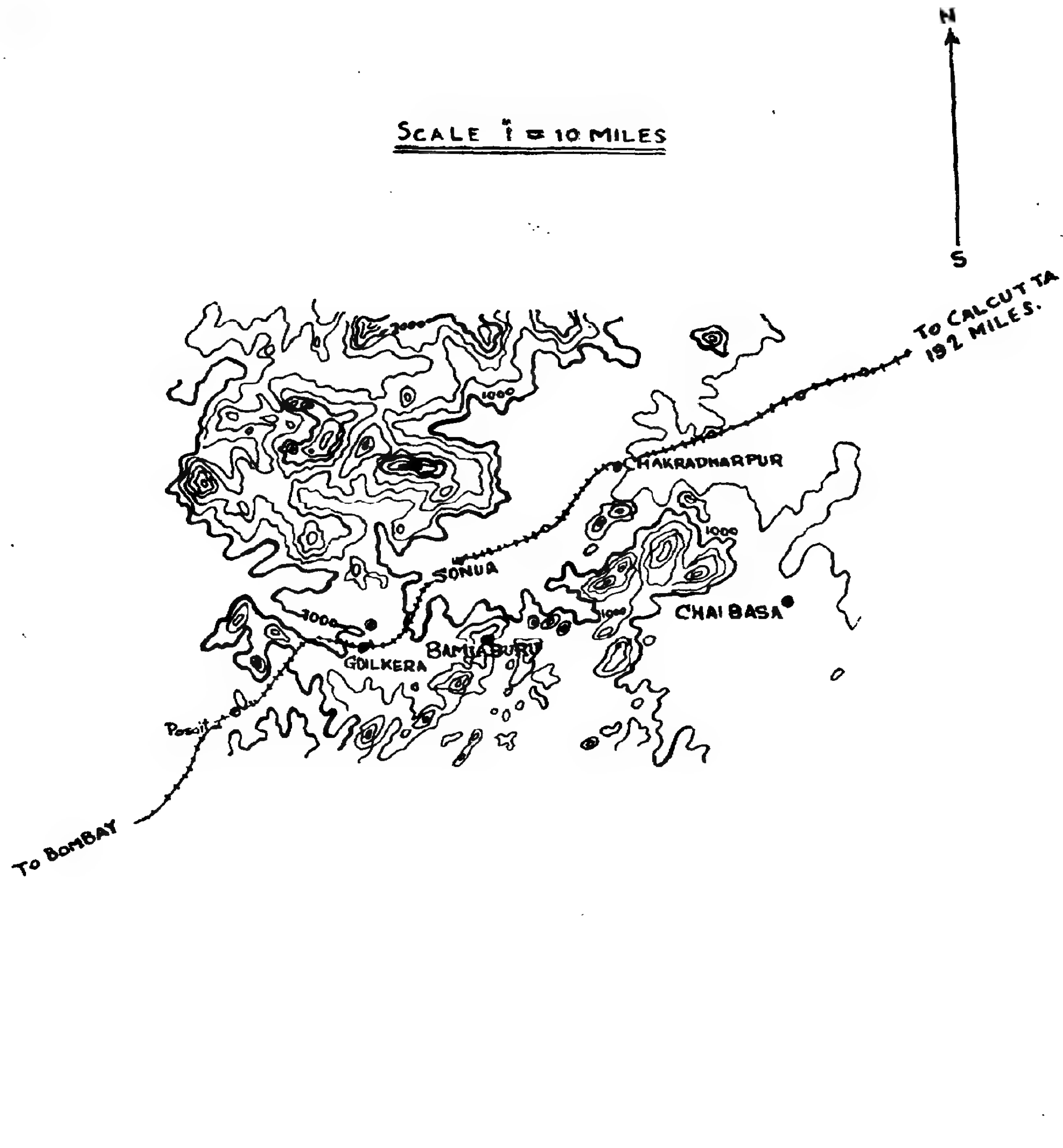
Summary.—The first four-year climatic cycle analysis of the four rainfall recording stations nearest the Bamiaburu contouring experiment shows indications of climatic change up to sixteen miles away, in the open. The change consists chiefly of better distribution of rainfall in the pre- (south-west) monsoon and post-monsoon months (May, June and October). A spectacular rise in total rainfall was also recorded at Sonua, six miles from the area, and three miles into the open, and a satisfactory rise at Chakradharpur, sixteen miles away. The number of rainy days shows a corresponding satisfactory increase in the months of increased rainfall. At Chaibassa, 14 miles from the experiment, and ten miles into the open, relative humidities show increasing rises from February until May (6), decreasing rises from June to October, and big decreases from November till January. Maximum temperatures were cooler from May till November, and warmer for the winter months of December—March, except for February. Minimum temperatures were warmer than normal on the whole, the exceptions being June (— .9°F) September (— .7°F) and November (— .1°F). The diurnal range of temperature on the whole is less than normal. No proofs are claimed as the experiment is a long term one.

THE FIRST FOUR-YEARLY CLIMATIC CYCLE ANALYSED

Situation.—Situated in the Chota Nagpur hills, Bihar, India, the Kolhan Forest Division in which this large scale experiment has been carried out, occupies the north-eastern part of that portion of the Singhbhum Forests lying to the south of the Bengal-Nagpur Railway. Adjoining it to the south-west, lies the Saranda Division, while across the railway to the north lies the Porahat, all three forest divisions forming a fairly compact block of 800 square miles of forests.

Except for the outlying hills of the Saitba Block to the north-east of the experiment and for isolated peaks in Leda Block to the west, the hills of Kolhan Division rarely exceed 2,000 feet in height, whereas those to the south-west in Saranda, and to the north in Porahat, are higher on the average with several peaks of more than 2,500 ft., and with the Sasangda Buru Plateau in the south-east of Saranda attaining 3,000 feet.

Climate.—The climate is tropical, influenced by the south-west monsoon, with three distinct seasons: the hot, the rainy and the cold. The hot season lasts from March until the end of May


SCALE 1" = 10 MILES
N
S
TO CALCUTTA 192 MILES.
CHAKRADHARPUR
SONUA
CHAIBASA
GOILKERA
BAMIABURU
Posoita
TO BOMBAY
2000
1000

or early June, during which period temperatures at Chaibassa may occasionally soar to as much as 115° F. This is followed by a transition period until the end of June. The rainy season lasts from the beginning of July until the end of September, with extensions in some years into October, and the cold weather lasts until the end of February

Rainfall.—Protected from the moisture-laden south-west monsoon winds by the higher hills of the Saranda Division, the Kolhan suffers from being in what climatologists would call a "Rain Shadow", that is, with a dryer climate than Saranda. As an example one storm from the south-west in 1937, gave seven inches of rain at Tholkobad in the south-west of Saranda (height 1,800 ft.) three inches at Goilkera—(height 1,000 ft.) in Kolhan Division, and only one inch at Chaibassa, (height 800 ft.). Whereas Saranda's total rainfall averages 60—80 inches (perhaps even more at Tholkobad), Kolhan's rainfall is only 52 inches at Chaibassa, Chakradharpur and Sonua (interpolated) and 60 inches at Goilkera. Their rainfalls would be even less, but for indrafts from the Bay of Bengal. The difference between a peak year and depression year at Chaibassa, seems to lie in the number of cyclonic storms which travel in from the Bay of Bengal in a north-westerly direction to peter out usually, in the United Provinces. Thus in 1937, a peak year of rainfall, when Chaibassa registered 67 inches of rain, there were seven cyclonic storms carefully recorded and charted by the Meteorological Department, Poona, while in 1938, a year of short rainfall, with only 38 inches of rain, there was only one cyclonic storm.

Distribution of Rainfall.—Out of a total annual rainfall of 52 inches at Chaibassa, the bulk, nearly 32 inches, falls within the monsoon period of July, August and September. Of the remaining twenty inches, nearly nine inches (8.76) fall in June, and nearly three inches (2.94) in October leaving only eight inches of rain for the other seven months of the year.

History of the Experiment.—The experiment was first begun in 1933 near Bamiaburu (*see map in* plate 25) on the 1,500-foot contour in a very dry valley, the stream of which dried up in December each year. (Later experience taught us that the run-off

from the hillsides alone was sufficient to keep the trenches filled for some hours after each shower of rain, without having to rely on perennial or semi-perennial streams.)

The condition of the forest crop traversed by the trench system was very bad,—open dry hill type quality IV Sal, usually going unsound before reaching its economic exploitable diameter of 16 inches.

Construction at first was slow, only 500 yards of trench being dug the first year and half a mile the second, so that by the end of 1935 less than three miles had been dug.

More funds then became available, and with enthusiasm stimulated to fever-pitch by the encouraging vegetative response to the earlier efforts, construction was speeded up, so that by March 1939, sixty-four miles of trenches had been dug on the undulating Bamiaburu Plateau, and in the Roro valley below to the north-east, 14 miles from Chaibassa.

First Signs of Climatic Change.—It was in January 1936, that the experiment was first suspected to have a climatic value, when small clouds in the process of formation were noticed high up over the area with portions continually breaking off to disappear as the wind took them away from the humidifying influence. Formation kept pace with disintegration so that the clouds never grew less in size.

Later, clouds were to fill the sky to beyond the horizon and that is a common phenomenon now.)

About the same time, January 1936, a mild storm fell on the area and to the leeward, but nowhere else within the locality, which deepened the suspicion of local climatic improvement. Again at the end of May and early June of that year light showers would fall in the day time within the trenched area, but not outside it. On arriving back at Bamiaburu only $1\frac{1}{2}$ miles away, one would be surprised to find that no rain had fallen there.

However, it is not considered that the experiment, because of the limited extent of the first three years' work, could have exerted any influence on rainfall-recording stations outside the forest area until at least the 1936 or even the 1937 rains. The analysis of climatic data for the four stations—Sonua, Goilkera, Chakradharpur and Chaibassa—nearest to the experiment will therefore begin

from that year 1936. The Inspector-General Meteorological Stations. Poona, after certain mathematical tests (*see* article *Indian Forester*, January 1942) has lately admitted that the climate of Chaibassa probably has a four-yearly rhythmic rainfall cycle, of peaks, depressions and normal rains. As the other climatic factors are largely influenced by the amount and distribution of the annual rainfall, it follows that most, if not all, of the changes in the weather which the locality can experience will be experienced during each four-yearly rainfall cycle. Climatic data for 1936-39 for the above-mentioned stations are now available and are examined below. (It might be mentioned in passing that a rainfall, temperature and humidity-recording station was established at Bamiaburu in October 1936, but as the micro-climate had probably changed by then, "precise records of climatic change" in the words of the Poona authorities cannot be obtained, and so no useful purpose is served by bringing its data under review. The climatic data of Roro must also be rejected for the same reasons.) It is a pity of course that the precise climatic modification the experiment has made *in our forests* will remain unknown, but as the experiment in its original conception was purely a silvicultural one,—the climatic indication came as a great surprise—no blame can be attached to the author of the scheme.

SONUA'S CLIMATE

A reference to the map will show that Sonua is the nearest rainfall, and rainy day recording station to the experiment. It lies, as the crow flies, about six miles to the north of the nearest point of the irrigation system, and three miles into the open across paddy fields. Unfortunately it has no normal. However statistics have been collected since 1932, and so the averages for the climatic cycle 1932-35 duly modified can be used as a normal (on the assumption that it possesses the same climatic cycle as Chaibassa) for comparison, with the 1936-39 cycle.

The modification consists of levelling up each month's data, by the average amount of fluctuation from normal, found in the other three stations under review. As these stations are on three sides of Sonua and not too far away, it is reasonable to suppose that any deviation from normal in Sonua's climatic cycle would be reflected in their climates also. Here are the figures:

SONUA'S RAINFALL

Month	1932—35	Average ± of the three stations from Normal	Interpolated Normal	1936—39	Difference compared with 1932—35	Difference compared with Interpolated Normal
January ..	0·29	0·36	0·65	0·58	0·29	(—)0·07
February ..	1·33	(—)0·06	1·27	1·85	0·52	0·58
March ..	0·18	0·38	0·56	0·81	0·63	0·25
April ..	0·57	0·52	1·11	0·57	0·00	(—)0·54
May ..	1·30	1·36	2·66	3·52	2·22	0·86
June ..	4·97	2·90	7·87	12·10	7·13	4·23
July ..	16·50	(—)3·26	13·24	13·95	(—)2·55	0·71
August ..	12·33	0·60	12·93	14·33	2·00	1·40
September ..	9·21	(—)1·03	8·18	7·89	(—)1·32	(—)0·29
October ..	1·22	1·87	3·09	3·96	2·74	0·87
November ..	0·61	0·02	0·63	0·16	(—)0·45	(—)0·47
December ..	0·09	0·06	0·15	0·05	(—)0·04	(—)0·10
Total ..	48·60	3·72	52·34	59·77	11·15	7·43

SONUA'S RAINY DAYS

Month	1932—35	Average ± of the three stations from Normal	Interpolated Normal	1936—39	Difference compared with 1932—35	Difference compared with Interpolated Normal
January ..	1·00	0·43	1·43	1·50	0·50	0·07
February ..	2·00	(—)0·17	1·83	4·50	2·50	2·67
March ..	0·50	0·14	0·64	1·75	1·25	1·11
April ..	2·00	0·42	2·42	1·25	(—)0·75	(—)1·17
May ..	2·75	2·03	4·78	6·25	3·50	1·47
June ..	10·75	1·18	11·93	14·00	3·25	2·07
July ..	18·25	(—)2·95	15.30	19·50	1·25	4·20
August ..	18·25	(—)0·18	18·07	17·75	(—)0·50	(—)0·32
September ..	13·00	(—)1·73	11·27	13·00	—	1·73
October ..	3·00	1·32	4·32	6·00	3·00	1·68
November ..	1·00	(—)0·89	0·11	0·25	(—)0·75	0·14
December ..	0·25	(—)0·02	0·23	Nil	(—)0·25	(—)0·23
Total ..	72·75	(—)0·42	72·33	85·75	11·50	13·42

The chief thing to notice is that Sonua's average annual rainfall has leapt up from 48.60 inches, the actual averages of 1932-35, to 59.77 inches for the 1936-39 cycle—an increase of 11.17 inches, that is, during the second cycle, 44.52 inches more rain fell than in the preceding period! Even compared with the interpolated normal, the annual gain is 7.43 inches or 29.72 inches for the period! Of even greater significance is the fact that as compared with the actuals of 1932—35, none of the gain occurs within the monsoon period! (The gain in August is more than counter-balanced by the loss in July!) It occurs chiefly in May, 2.22 inches; June, 7.13 inches; and October, 2.74 inches! Even as compared with the interpolated normal, there is a very satisfactory gain of .86 inches in May, 4.23 inches in June, and .87 inches in October. Thus no one can say that the gains were due to more favourable Monsoon precipitations during this climatic cycle.

The total number of rainy days has increased by 13,00, or 13.42 over the interpolated normal. This also is rather remarkable seeing that the average fiuctuation of the other three stations from normal for 1932-35 was only 1.17 or less than half a rainy day with a maximum fluctuation of plus 6 for Goilkera. We find, as with the rainfall, that the rainy day pluses are chiefly in May, June and October. As compared with the interoplated totals, the biggest gain is in July during the Monsoon period though May, June and October still have satisfactory pluses. There is also a satisfactory increase in February corresponding to the half-inch increase rainfall during that month.

CHAKRADHARPUR'S CLIMATE

Chakradharpur is about sixteen miles from the contour trenching system to the north-east. It has an established normal. Here are the figures for 1936—39 compared with that normal:

CHAKRADHARPUR

Month	Rainfall			Rainy Days		
	Normal	Rainfall average 1936-39	Difference	Normal	Average 1936-39	Difference
January ..	0·77	0·62	(—)0·15	1·20	1·25	0·50
February ..	1·23	1·71	0·48	2·00	4·75	2·75
March ..	0·72	0·46	(—)0·26	1·70	0·75	(—)0·95
April ..	1·00	0·36	(—)9·64	2·30	1·00	(—)1·30
May ..	3·17	5·29	2·12	5·60	5·75	0·15
June ..	9·25	11·24	1·99	11·70	13·75	2·05
July ..	12.62	10·69	(—)1·93	14·90	15·50	0·60
August ..	12·03	12·06	0·03	16·30	16·25	(—)0·05
September ..	8·01	8·33	0·32	11·40	14·50	3·10
October ..	2·53	4·77	2·24	3·90	5·25	1·35
November ..	0·59	0·01	(—)0·58	0·09	Nil	(—)0·09
December ..	0·17	0·01	(—)0·16	0·30	Nil	(—)0.30
Total ..	52·09	55·55	3·46	71·39	78·75	7·36

It will be noticed that even here, sixteen miles from the area, the rainfall has gone up by 3.46 inches during the 1936—39 period as against its normal. In this case also the chief gains are 2.12 inches for May!, 1.99 inches for June! and 2.22 inches for October with .48 inches in February, while the Monsoon Period averages 1.6 inches less than normal. The Rainy days have increaseed by 7.36, the increases being in the months of increased rainfall.

GOILKERA'S CLIMATE

Goilkera is ten miles to the West of the experimental area. Its figures are given below:

GOILKERA

Month	Rainfall			Rainy days		
	Normal	Average 1936—39	Difference	Normal	Average 1936—39	Difference
January ..	0·73	0·50	(—)0·23	1·30	1·25	(—)0·05
February ..	1·26	2·07	0·81	1·60	2·50	0·90
March ..	0·78	0·65	(—)0·13	1·60	1·50	(—)0·10
April ..	1·13	0·38	(—)0·75	2·20	1·50	(—)0·70
May ..	2·27	2·47	0·20	4·20	4·50	0·30
June ..	10·05	10·12	0·07	11·90	13·25	1·35
July ..	15·89	16·27	0·38	16·90	23·25	6·35
August ..	16·51	14·69	(—)0·82	19·00	17·00	(—)2·0
September ..	7·99	9·62	1·63	11·50	13·50	2·0
October ..	4·00	3·81	(—)0·19	3·80	4·75	0·95
November ..	0·29	0·07	(—)0·22	0·50	0·25	(—)0·25
December ..	0·22	Nil	(—)0·22	0·30	Nil	(—)0·30
Total ..	61·12	60·65	(—)0·47	74·80	83·25	8·45

Strangely enough although it is nearer the area than Chakradharpur, its total rainfall shows a slight decrease! Nevertheless, its distribution has improved slightly with a gain of .2 inches in May, negligible gain in June!, and an increase of 1.63 inches in September. Its rainy days, also a factor in rainfall distribution, have gone up however by 8.45 with *a surprising gain of 6.35 rainy days for* July! February, May, June, September and October all share the improvement.

(*To be continued.*)

ADVANCE THINNING FOR TEAK PLANTATIONS

BY A. B. LAL, B.SC.,

Range Officer, Kanker State, E. S. A.

The type of thinning and the most suitable thinning regime, applicable to teak-plantations, is still in the melting-pot. The common practice, followed at present, is to perform the first two juvenile thinnings on the basis of the height attained by the dominant trees, *regardless of the quality of the site.* The first thinning is done at 20—25 feet height and the second at 35—40 feet. The subsequent thinnings are, mainly, C-D grade of the ordinary type, on some mechanical basis. The Central Provinces are experimenting upon the applicability of *Heck's Frei endürchforstung* and it will be interesting to watch the results of the experiment.

The application of ordinary thinning, after the formation of crown-differentiation, carries with it serious disadvantageous effects, of which the chief are the following:

1. Teak is an intolerant species and in the drier regions, like the C. P., C. I., and parts of Bombay, the closure of the root-complex takes place earlier than that of the crown. The crown-density may be open with each tree standing free, while at the same time the root-density may be full with a more or less continuously interwoven root-complex. The effect of root-competition, therefore, begins telling upon the trees long before the crown-differentiation manifests itself and may so seriously affect the trees that they may lose all power of recuperation and may not, afterwards, respond to extra soil-moisture and light. The fact that teak is a vigorous root-competitor can be easily seen by the complete exclusion of lesser vegetation from the floor of a teak-plantation, long before the canopy. Teak is regarded as an arch-enemy of agriculture and it is known to lay cultivators that it does not allow any agricultural crop to grow beneath and around it due to the heavy demand that it makes on the superficial layer of the soil for moisture and nutrients.

The seeding felling which is done in a teak forest is, in my opinion, concerned more with the reduction of root-competition than with the adjustment of light-conditions.

In the rab teak-plantations of the western Thana division of Bombay, with hardly a few inches of soil, where moisture, rather than light, is the limiting factor, the application of *ordinary* thinnings, after the formation of crown-differentiation, is open to criticism and much can be said against it. The same applies for the drier parts of C. P. and Central India.

2. Even in moist localities, such as parts of Madras, where light, rather than moisture, is the limiting factor, the efficacy of *ordinary* thinning may well be doubted. It is a common observation that teak trees avoid interlacing their branches after dominance and suppression has taken place among them. The crop, as a result, does not look congested and even an expert forester is apt to commit the mistake of postponing thinnings considerably.

Cedrus deodara also exhibits this peculiarity as a result of which there is a school of thought which expresses grave doubts as regards the suitability of *ordinary* thinnings for the species.

3. The researches of Dr. Koenitz show that in every tree there are two sets of leaves, namely the sun-leaves (which are directly exposed to the sun) and shade-leaves (which are comparatively in shade). It is only the sun-leaves which are active and perform work of photosynthesis; shade-leaves, on the other hand, are completely inert. They can not only not manufacture food for themselves but have to depend upon the food manufactured by the sun-leaves for their maintenance. Shade-leaves are, therefore, a liability to the tree and adversely affect its growth. Ordinary thinning of C-D grade involves the retention of some trees of suppressed and dominated class, which cast side-shade on the dominant trees resulting in the formation of shade-leaves. The disadvantageous effect of shade-leaves is further augmented in the case of light-demanders, like teak, in which, if a tree remains in shade, there is a possible danger of the sun-leaves turning permanently into shade-leaves, in due course, and the tree losing all power of recuperation, thereby.

4. The idea of *maximum sustained yield* is the sheet-anchor of all forest management works and this is especially so with plantations, which involve the expenditure of a considerable sum

of money. *Maximum sustained yield* is obtained by the full utilisation of the site. In the case of teak, full root-complex, and not full leaf-canopy, should be taken as the true index of the complete utilisation of the site. *There is a danger involved in having an unbroken canopy in teak-plantations; that may lead to overstocking, dwarfing of all the trees, falling off in the rate of growth and a lengthening of the rotation period.*

Owing to the disadvantages mentioned above, *ordinary* thinnings carry with them vast potential dangers. Their application may cause to the crop almost an irretrievable damage and, thereby, kill the goose that lays the golden eggs. It is, therefore, time for us to take stock of the situation and modify the thinning procedure.

Of late, there has been too much of a tendency in Indian silvicultural practice to combine *ordinary* with *mechanical* thinnings and to pay relatively greater importance to the *mechanical* side of it. The silvicultural requirements of the trees are subordinated and spacement between trees is given dominant importance. *Mechanical* thinnings, as a matter of fact, cannot be applied to all crops, at random. There are certain conditions which a crop *must* satisfy before it can be subjected to *mechanical* thinning. The conditions are: (*a*) the crop should be free from crown-differentiation; (*b*) there must be uniformity of growth; (*c*) the area must be fully stocked. The conditions for the applicability of *ordinary* and *mechanical* thinnings are, therefore, quite conflicting and *mechanical* thinning can never be done in a crop once the crowns have differentiated themselves. More often than not, such a combination results in the retention of a bad stem and cutting down of a good one. The crop, after being subjected to the composite operation, presents a queer appearance. It neither causes a marked reduction in root-competiton nor does it make any striking difference in the light-conditions of the *élite* stems. The main purpose of thinning, which is to provide for each tree the suitable growing space that it requires is, thereby, defeated and the play becomes a mere flop. A forest crop is a complex biological unit *and resents all attempts at being guided by any rigid principles of mathematics.*

To get over the disadvantages of *ordinary* and *ordinary-cum-mechanical* thinnings, *advance* thinning offers the best solution. The essential feature of this thinning is that crown-differentiation is never allowed to take place in the crop; suppression, on the other hand, is anticipated. All the trees belong to one crown class, namely the dominant class, and this offers the ideal condition for the application of mechanical rules. The number of stems is reduced, rather vigorously and at frequent intervals, from early stage onwards and this is continued until the required number of stems, per acre, has been obtained.

The main disadvantages of advance thinning, some of which have been rather over-exaggerated, are:

1. *Branchiness of the tree*:—This is a defect with all the modern methods of thinning, which tend to be of the heavier type, and can be easily remedied by pruning, which is sure to come to the fore in Indian silvicultural practice, sooner or later. A beginning has already been made with *deodar* and *mulberry* in Punjab, where pruning is done and coal-tar applied at the cut ends to have timber free from knots.

There are indications that branchiness in teak is also a racial character and Allapally teak of C.P. grows comparatively straighter and free from the defect of branchiness than other varieties. A wide spacement of 12 ft. × 12 ft. is, therefore, adopted for planting teak in the P.B. I. areas of the conversion working circle.

2. *Soil deterioration and weed invasion.*—It is a pity that our ideas regarding the nature of gap are far from correct and need a complete revision. A smaller gap is not necessarily temporary and bigger gap not necessarily permanent. *The nature of a gap depends primarily upon the amount of extra soil-moisture and light and secondly upon the capacity of the trees to respond to the extra stimulus.* A smaller gap, caused by the removal of a few suppressed and dominated stems, such as is made in *ordinary* thinning is, therefore, much more permanent in nature than a bigger gap made in advance thinning, with a severe reduction in root-competition, to which the trees respond with amazing rapidity.

3. *Deterioration in the strength of the timber.*—This is, no doubt, a defect but is not of a serious nature taking into considera-

tion the trend of the timber market which shows that in future there is likely to be a very little demand for structural timbers on account of the competition by steel and concrete. It is therefore a wise and foresighted policy not to allow the capital to be locked up for an uncertain future market and an effort should be made to get as early a return on the investment as possible by subjecting teak plantations to advance thinning which involves a considerable reduction in the rotation period.

Craib and O'Connor have obtained most astounding results with the application of advance thinning, at interval of months, to *wattle* plantations in South Africa. Craib's results form a landmark in the history of Forestry because it was he who, for the first time, demonstrated that in the case of intolerant species root-competition, and not light, plays the dominant part in thinning operations. Craib is the originator of another revolutionary idea in forestry which is quite the reverse of our present-day ideas and practices. He says that thinning should be done heavier in poor localities than in better localities in order to have crop of the same diameter in both the cases. Although *wattle* is a short-rotation crop, there is no reason why the general theory of Craib should not be applicable to long-rotation, intolerant crops also. In view of its potential merits, it deserves a fair trial, in India, for teak and other intolerant, fast-growing species. The game, in my opinion is worth the candle.

Advance thinning has so far been a neglected child in Indian silvicultural practice and the objections against it are, perhaps, the same as against the other heavier types of thinning. It is not an uncommon observation to see foresters exhibiting extreme fear and nervousness in carrying out heavy thinning. This fear-complex is partly the result of a wrong understanding of crop physiology and partly due to the old ideas which have become permanently fixed in our mind. Man is a victim of old traditions and habits and foresters are no exception to it.

Thinning, as a special branch of silviculture, has made rapid strides, during the past few years. The efficiency of a thinning of a thinning officer was, in the past, judged in the inverse proportion of the degree of opening made by him in the canopy. A radical change has taken place, since then. The modern idea regarding

thinning is that if a thinning officer does not feel shocked when the trees marked by him have been felled, he should take it for granted that he has not done his job well and has, perhaps, thinned the area too lightly.

In tending operations, whereas the old maxim was "When in doubt, leave", the new maxim is likely to be "When in doubt, cut". Does that not show the way wind is blowing nowadays?

SOME COMMON FODDER-YIELDING TREES IN THE MADRAS PRESIDENCY—I

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Providing fodder for cattle during dry periods and in times of famine is an acute problem which the farmer has to face very often. During such periods, especially in Famine times, the poor cultivator is very often obliged to dispose of his live-stock at ridiculously low prices, or has to migrate to other more favourable localities, despite the hardships that such a step would necessarily involve. To safeguard against such times it is very essential that some sort of fodder reserve should be built up which would at least alleviate the distress of fodder famine if not completely avoid it. Ensilage of grass is a recent attempt made to provide fodder for cattle during dry periods. Another method of building up a fodder reserve is to grow trees which will provide fodder for cattle in times of need. There are a large number of fodder-yielding trees in our presidency, whose fodder value is little or not known to the general public, though some of them are often planted in the avenues and gardens for ornamental purposes. In this paper some of the common fodder-yielding trees found in our presidency are mentioned with their local names and with short notes on their main characteristics, part or parts of the plant eaten by cattle, ecological distribution and method of propagation. An index to popular names of the trees is also appended to part II of this article. The list is in

no way exhaustive but includes a sufficiently large number of trees, which are fairly quick growing, drought-resistant and produce plenty of foliage, from which selection could be made to suit the needs of different localities in the province. The ecological distribution will be helpful to select plants most likely to thrive well in a particular locality. In any scheme of tree planting, it is suggested that in selecting trees, their fodder value is also borne in mind. The planting of such trees should be encouraged in all waste places and in soils where crops cannot be profitably raised, and thus create "fodder-cum-fuel" reserves. Besides utilising the lands which otherwise would lie waste, an additional source of fodder is created for our half-starved cattle which are the backbone of Indian agriculture. Though the returns of such an enterprise are slow and not often directly realised, the plantations are a national asset and increase the general wealth of the country.

1. *Acacia arabica* Wild. Fam: *Leguminosae.*

Tam: *karuvelam;* Tel: *nalla thumma.*

A moderately-sized tree, with golden-yellow flowers, long white thorns and dark-brown rough bark; wood reddish brown, hard and strong, useful for making agricultural implements. The pods which are long (8—10 in.), beaded and with white tomentose hairs are readily eaten by cattle, sheep and goats. When ripe the pods fall to the ground and are greedily picked up by the animals. The leaves and tender shoots are eaten by sheep and goats.

Distribution.—Circars, Deccan and Carnatic, in dry localities especially on old tank beds and black cotton soils; occasionally found in southern districts.

Propagation.—By seeds. Suitable for planting in pasture areas, waste lands and tank beds.

2. *Acacia Catechu* Wild. Fam: *Leguminosae.*

Tam: *karungali;* Tel: *sundra.*

A moderately-sized deciduous tree with pale yellow flowers; bark dark grayish brown; wood red and hard and from it the tan "Cutch" is extracted. The leaves are eaten by sheep and goats.

Distribution.—Limited to N. Circars, in Ganjam.

Propagation.—By seeds. Can be planted in pasture lands and waste places.

3. *Acacia leucophloea* Wild. Fam: *Leguminosae.*

Tam: *velvelam;* Tel: *tella thumma.*

A moderately-sized tree with pale yellowish white flowers and less thorny than *A. arabica.* Bark whitish-gray when young and brown when old; wood hard and tough. Pods are small, 2—2½ in. long, flattish, curved and are readily eaten by cattle, sheep and goats. The leaves and tender shoots are eaten by sheep and goats.

Distribution.—Circars, Deccan and Carnatic, in dry places and deciduous forests and occasionally in some southern districts.

Propagation.—By seeds; can be planted in pasture areas, waste places and tank beds.

4. *Adina cordifolia* Hook. Fam: *Rubiaceae.*

Tam: & Mal: *manja kadambe;* Tel: *bandaru;* Kan: *ahnau.*

A large, beautiful deciduous tree with large acuminate leaves and yellow flowers in small heads. Bark thick, grey, rough; wood yellow, moderately hard and used for agricultural implements, combs, etc. Young trees are often cut for house posts. The leaves are eaten by cattle, sheep and goats.

Distribution.—In all dry deciduous forests throughout the presidency and occasionally on old cultivated lands.

Propagation.—By seeds; can be planted in avenues and waste places.

5. *Aegle Marmelos* Corr. Fam: Rutaceae. (*beal* tree).

Tam: *vilva;* Tel: *maredu;* Mal: *kovalam.*

A small deciduous thorny tree. The fruit is valued for its medicinal use. The young shoots and leaves are eaten by cattle, sheep and goats.

Distribution.—N. Circars, Deccan and Carnatic, in dry forests; elsewhere run wild; often cultivated.

Propagation.—By seeds; can be planted in gardens and waste places.

6. *Ailanthus excelsa* Roxb. Fam. *Simarubaceae.*

Tam: *perumaran, peemaran:* Tel: *peddamanu, pee vepa-chettu.*

A large beautiful tree with rough grey bark and soft white wood, growing up to 40 to 50 feet high; gives plenty of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—N. Circars, forests of Ganjam and Vizagapatam; often planted.

Propagation.—By seeds. A good avenue tree

7. *Albizzia amara* Boiv. Fam. *Leguminosae.*

Tam: *wunja, thurinji;* Tel: *chiguru chettu, nalla renga;* Mal: *varacchi.*

A moderately-sized deciduous tree with pinkish white flowers. The wood is purplish-brown, very hard and used for making agricultural implements. The leaves form a good fodder and are readily eaten by cattle, sheep and goats. A few semi-wild breed of cattle occurring in parts of Salem and N. Arcot districts are said to depend mainly on the young leafy shoots of this tree. The leaves are dried, finely powdered and used for bathing purposes either alone or mixed with soap-nut powder.

Distribution.—N. Circars, in Vizagapatam and Godavari; Deccan and Carnatic, in dry forest lands, to South Travancore and up to 3,000 feet.

Propagation.—By seeds; can be planted in avenues and waste places.

8. *Albizzia Lebbeck* Benth. Fam: *Leguminosae.*

Tam: *vagei;* Tel: *dirasana;* Mal: *vaga.*

A large deciduous tree, with large white flowers and characteristic long and flat pods remaining on the tree when ripe. Wood dark brown, hard and useful for making agricultual implements. The tree yields plenty of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—In all plains districts throughout the presidency; cultivated and run wild.

Propagation.—By seeds. A good avenue tree.

9. *Albizzia marginata* Merr. Fam: *Leguminosae.*

Tam. *pili vagei;* Tel. *konda Chiragu;* Mal. *potta vaga.*

A large deciduous tree with white flowers and pink filaments. Bark grey; wood brown and soft. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—N. Circars and Deccan, in hill forests; W. Ghats in deciduous forests and up to 3,000 feet or higher; sometimes planted as shade tree for coffee.

Propagation.—By seeds; a good avenue tree.

10. *Albizzia odoratissima Benth.* Fam: *Leguminosae.*

Tam: *karu vagei;* Tel: *chinduga;* Mal: *puli vaga.*

A large tree with sweet-scented white flowers. Bark dark grey; wood dark brown and hard and useful for making agricultural implements especially for wheels and oil-mills. Leaves are produced in plenty which are readily eaten by cattle, sheep and goats.

Distribution.—In all forest districts throughout the presidency and up to 3,000 feet in the hills.

Propagation.—By seeds; a good avenue tree.

11. *Albizzia procera* Benth. Fam: *Leguminosae.*

Tam: *konda vaghe*; Tel: *tella chinduga;* Mal: *karumthagara.*

A very large deciduous tree, conspicuous for its yellowish white bark and head of spreading branches. Flowers greenish white and small. Wood brown and hard and useful for making agricultural implements. The tree gives a fair amount of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—N. Circars and Deccan, in hill forests; W. Ghats, in deciduous forests. Often planted for ornament or in avenues.

Propagation.—By seeds; a good avenue and ornamental tree.

12. *Anogeissus latifolia* Wall. Fam: *Combretaceae.*

Tam: *valley Naga*; Tel: *chiriman*; Mal: *mara kanchiram.*

A large deciduous tree, conspicuous by its smooth grey bark and by the leaves turning red before falling. Wood grey and hard and useful for agricultural implements; also a very valuable fuel. The leaves are readily eaten by cattle, sheep and goats and also used in tanning.

Distribution.—In all dry deciduous forests of the presidency up to 4,000 feet.

Propagation.—By seeds; can be planted in waste and uncultivated areas.

13. *Artocarpus integrifolia* Linn. Fam: *Moraceae.*

Tam: *pila*; Tel: *panasa;* Mal: *pilavu;* Kan: *halasu.*

A large evergreen tree. Bark black mottled green and smooth; heart wood bright yellow and used for carpentry. The tree produces plenty of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—In evergreen forests of the W. Ghats, 1,500—4,000 feet; cultivated in many parts of the presidency for the edible fruit.

Propagation.—By seeds; a good avenue, shade and fruit tree.

14. *Azadiracta indica* A. Juss. Fam: *Meliaceae.*

Tam: *vepa*; Tel: *vepa, yapa*; Mal: *veppa*; Kan: *bevina-mara.*

A very important and useful deciduous tree with hard close-grained wood giving a valuable timber. The bark, leaves, flowers and seeds are medicinal. The leaves are eaten by sheep and goats and by cattle in some localities.

Distribution.—Dry forests of the Deccan and Carnatic. Planted throughout the presidency as an avenue tree and often run wild.

Propagation.—By seeds; a very good avenue and shade tree.

15. *Balanites Roxburghii* Planch. Fam: *Simarubiaceae.*

Tam: *Nanjunda*; *teli gari.*

A small thorny tree with ashy grey foliage, grey bark and yellowish white wood. The leaves are eaten by cattle, sheep and goats.

Distribution.—N. Circars, in Vizagapatam; Deccan, Ceded districts and Mysore in dry forests; also in black cotton soils and scattered throughout the presidency.

Propagation.—By seeds; can be grown in waste and uncultivated areas.

16. *Bambusa spp.* Fam: *Gramineae.* (Bamboo.)

Tam: *mungil*; Tel: *vedura*; Mal: *mulla, molai*; Kan: *dongi.*

There are two species of *Bambusa* occurring in Madras of which *B. arundinacea* Willd. occurs in all the districts from 100 to 4,000 feet. Used for building, scaffolding and for many domestic purposes. The split culms are woven into mats, baskets, fans, etc. The grain when available is eaten by the poor. The leaves like any other grass, form a good fodder for the cattle.

Propagation.—By seeds and by clumps; can be planted in gardens and in vacant areas of heavy rainfall.

17. *Bauhinia malabarica* Roxb. Fam: *Leguminosae.*

Tam: *malayathi*; Tel: *puli shinta, puli chinta, are*; Kan: *cheppura.*

A moderately-sized deciduous tree with cream coloured flowers. The leaves are acidic and are eaten by sheep and goats and to a less extent by cattle.

Distribution.—No. Circars, in the Guntur Sal forests and in the Godavari forests; W. Ghats, in deciduous forests, from South Kanara to Travancore.

Propagation.—By seeds; can be planted in avenues and waste places.

18. *Bauhinia purpurea* Linn. Fam: *Leguminosae.*

Tam: *mandari*; Tel: *kanchanam, bodanta chettu.*

A moderate-sized evergreen tree often bushy with large leaves. Bark grey to brown; wood dark brown, moderately hard, used for implements. The leaves are eaten by cattle, sheep and goats. The leaves and young flower buds are used as vegetables.

Distribution.—N. Circars, Deccan and Carnatic, in deciduous forests, chiefly along water courses; W. Coast, in dry forest lands; often planted in gardens.

Propagation.—By seeds; a good ornamental tree in gardens.

19. *Bauhinia variegata* Linn. Fam: *Leguminosae.*

Tam: *Segapu-manchori*; Tel: *mandari*; *bodantham.*

A moderate-sized deciduous tree. Bark grey; wood greyish-brown, moderately hard. The leaves are eaten by cattle, sheep and goats. The young leaves and flower buds are a leafy vegetable.

Distribution.—N. Circars, Deccan and Carnatic, in dry deciduous forests especially on rocky hills; often cultivated for its beautiful appearance in flower.

Propagation.—By seeds; a good ornamental tree in gardens.

20. *Bassia latifolia* Roxb. Fam: *Sapotaceae.*

Tam: *illupei*; Tel: *ippa*; Kan: *ippi*; Mal: *ilupa.*

A large handsome deciduous tree. The large fleshy cream coloured corollas contain much sugar and are an important article of food and for the distillation of spirit. They fall readily from the trees when ripe and can be collected under them. The large ovoid greenish fruits have large fleshy cotyledons which give a valuable oil for burning. The leaves, flowers and fruits are eaten by cattle, sheep and goats.

Distribution.—In all deciduous forests of the presidency. Sometimes planted and in other places run wild.

Propagation.—By seeds; can be planted in avenues and gardens.

21. *Bombax malabaricum* DC. Fam: *Malvaceae* (red silk cotton.)

Tam: *ilavu*; Tel: *buraga*; Mal: *ilava*; Kan: *burla.*

A very conspicuous tree of gigantic size flowering when bare of leaves in the hot season. The carpellary cotton surrounding the seeds is used for stuffing pillows. The leaves are readily eaten by cattle, sheep and goats and the seeds can also be fed to cattle.

Distribution.—In all forest districts and occasionally in open country; often cultivated.

Propagation.—By seeds; can be planted in gardens and avenues.

22. *Buchanania angustifolia* Roxb. Fam: *Anacardiaceae.*

Tam: *mudamah, sara parupu*; Tel: *pedda sara, sara pappu.*

A medium-sized tree with rough, deeply-fissured bark. The leaves are readily eaten by cattle and the kernels of the seeds which have a pleasant flavour form a nourishing human food.

Distribution.—In all dry forests of the presidency.

Propagation.—By seeds; can be planted in avenues and gardens.

23. *Buchanania Lanzan* Spr. Fam: *Anacardiaceae.*

Tam: *morala*; Tel: *morli, Sara*; Kan: *nurkul*; Mal: *munga pera.*

A moderately-sized deciduous tree with rough bark and greyish brown wood. The leaves are eaten by cattle, sheep and goats and the kernels of the seeds are a nutritious human food.

Distribution.—In all deciduous forests of the presidency up to 4,000 feet.

Propagation.—By seeds; can be planted in avenues and gardens.

24. *Butea frondosa* Koern. Fam: *Leguminosae.*

Tam: *porasu*; Tel: *moduga*; Mal: *palasin samatha*; Kan: *muttaga.*

A deciduous tree, very conspicuous when in flower before the leaves appear, the large flowers being orange-scarlet set in dark velvety calyces. The leaflets are large and commonly used to serve as plates for taking food. The tree produces plenty of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—In all districts both in open country and deciduous forests; common on Black cotton soil and on salt lands.

Propagation. By seeds; can be planted in avenues and waste places especially on tank bunds.

25. *Cassia fistula* Linn. Fam: *Leguminosae*—(Indian Labernum.)
Tam: *konnei*; Tel: *rela*; Mal: *konna*; Kan: *kakke*.

A moderately-sized tree with pale smooth bark when young, darker and rough when old, recognized by its long racemes of bright yellow flowers and long cylindrical pods. Wood is hard and durable and useful for making agricultural implements. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—In deciduous forests in all the districts of the presidency and frequently planted in gardens and avenues as an ornamental flowering plant.

Propagation.—By seeds; a good avenue and ornamental plant.

26. *Cassia siamea* Lank. Fam: *Leguminosae*.
Tam: *manja konnai*.

A moderate-sized tree with yellow flowers in corymbs forming large terminal panicle. Bark grey; wood brown to nearly black hard and durable. The leaves are eaten by cattle, sheep and goats.

Distribution.—Carnatic, from Shevaroy Hills southwards—common in forests; extensively planted in avenues throughout the presidency.

Propagation.—By seed; a good avenue and ornamental tree.

27. *Cedrela Toona* Roxb. Fam: *Meliaceae*. (*toon* tree.)
Tam: *santhana vembu, thevadaram*. Mal: *methangirivembu*. Kan: *tundu*.

A large and beautiful tree with pinnate leaves, lanceolate long acuminate leaflets. Bark reddish and wood red moderately hard, useful for building and furniture. The young shoots, leaves and seeds are eaten by cattle, sheep and goats.

Distribution.—Eastern Ghats, in valleys and moist forest localities; Hills of Deccan in Kurnool, Sandur and Mysore; Western Ghats, up to 4,000 feet in evergreen forests. Often planted for ornament or in avenues.

Propagation.—By seeds; can be planted in the avenues and gardens.

28. *Cordia obliqua* Willd. Fam: *boraginaceae*.
Tam: *vidi*; Tel: *iriki, nakkeri*; Mal: *virusham*.

A moderate-sized deciduous tree with white flowers and yellow or pink ovoid glossy berries with accrescent calyx containing a mucilaginous transparent edible pulp. Bark grey; wood greyish

brown, moderately hard and useful for agricultural implements. The leaves are eaten by cattle, sheep and goats.

Distribution.—In all forest districts in deciduous forests. Sometimes cultivated.

Propagation.—By seeds; can be planted in avenues and gardens.

29. *Dalbergia latifolia* Roxb. Fam: *Leguminosae.* (black wood or rose wood.)

Tam: *eravadi;* Tel: *jitegi.*

A large deciduous tree. Bark thick and grey; wood extremely hard, dark purple used chiefly for furniture and agricultural implements. The leaves are eaten by cattle, sheep and goats.

Distribution.—N. Circars, scattered in hill forests, in all forests in Deccan, dry forests in Western Ghats.

Propagation.—By seeds; can be planted in gardens and waste places.

30. *Dalbergia Sissoides* Grab. Fam: *Leguminosae.* (Malabar Black Wood.)

Tam. *thothagatti;* Mal. *eetti, vitti, karitti.*

A large deciduous tree, giving a fine dark purple wood used in furniture making. The leaves are eaten by cattle, sheep and goats.

Distribution.—W. Ghats, from Mysore hills to the Pulneys and hills of Travancore up to 5,000 feet.

Propagation.—By seeds; can be planted in gardens and waste places.

31. *Dalbergia Sissoo* Roxb. Fam: *Leguminosae.*

A tree of river beds in the Sub-Himalayan tract of N. India and valuable for its hard dark brown wood used for furniture; often planted in S. India and sometimes found run wild. Leaves are eaten by cattle, sheep and goats.

Propagation.—By seeds; can be planted in gardens and waste places.

32. *Dolichandron falcata* Seem.

Tam: *katuvarsana;* Tel: *udda, wodi, chittivadi;* Kan; *wudige*

A small deciduous tree with white flowers. Bark bluish grey coming in scales; wood white and hard.

Distribution.—N. Circars, in Vizagapatam and Upper Godavari; Deccan and Carnatic in all dry deciduous forests; often on rocky slopes.

Propagation.—By seeds; can be planted in waste areas.

33. *Elaeodendron glaucum* Pers. Fam: Selastraceae.

Tam: *karuvali; kanniramaram;* Tel: *nirija, nerdi;* Mal: *karuniraka;* Kan: *kannur mara.*

A graceful evergreen tree with a grey bark and light brown close-grained wood useful for cabinet work. The leaves are eaten by cattle, sheep and goats.

Distribution.—Deciduous forests in all districts in the presidency.

Propagation.—By seeds; a good avenue and shade tree.

34. *Enterolobium saman* Prain. Fam: *Leguminosae* (rain tree.)

Tam: *thungu moonji;* Tel: *nidraganneru.*

A quick-growing moderately-sized tree, producing plenty of foliage which are eaten by cattle, sheep and goats. It is introduced from S. America, and is often grown as an avenue tree and thrives well in places of heavy rainfall.

Propagation.—By seeds; a good avenue tree.

35. *Eriodendron pentandrum* Kurz. Fam: *Malvaceae.* (White cotton or 'kapok' tree.)

Tam. *illavam panji;* Mal. *panjamaram, panya.*

A tall tree with smooth green stem and horizontal branches arranged in whorls. The carpellary cotton surrounding the seeds is used for stuffing pillows and is of better quality than that of *Bombax.* The leaves are readily eaten by cattle, sheep and goats, and the seeds can also be fed to cattle.

The tree is not indigenous but naturalised on the West Coast and often planted there and many other parts of South India.

Propagation.—By seeds; can be grown in gardens and waste places.

36. *Erythrina indica* Lam. Fam: *Leguminosae.* (coral tree).

Tam: *kalyana murunga;* Mal: *muruku.*

The tree is striking when in flower. Bark yellowish, smooth, shining; wood very soft and white. The leaves are eaten by cattle, sheep and goats.

Distribution.—Throughout the presidency wild on the East Coast. Planted in hedges and as a support for pepper.

Propagation.—By seed and stumps; can be planted in the avenues and gardens.

37. *Feronia Elephantum* Corr. Fam. *Rutaceae.* (wood apple).

Tam: *vila, vilatti;* Tel: *velaga;* Mal: *vila;* Kan: *bilwar.*

A small slow-growing deciduous spiny tree with yellowish white hard wood. The pulp of the fruit is much eaten. The leaves are eaten by sheep and goats.

Distribution.—N. Circars, Deccan and Carnatic, in dry open forests, often cultivated there and on the W. Coast and run wild throughout the presidency.

Propagation.—By seeds; can be planted in gardens.

38. *Ficus bengalensis* Linn. Fam: *Moraceae.* (banyan tree).

Tam: *al mamaram;* Tel: *marri;* Mal: *ala;* Kan: *alada.*

A very large tree throwing out numerous large aerial roots from the main trunk and large branches which descend to the soil and form supports. The tree produces plenty of foliage which is readily eaten by cattle and more specially by sheep and goats. The fruits which fall to the ground when ripe are also edible.

Distribution.—In all districts from sea level up to 4,000 feet. Largely planted in avenues and for shade for which purposes it is admirably suited.

Propagation.—By seeds as well as stumps; an excellent avenue and shade tree.

(*To be concluded.*)

TIMBER PRICE LIST, JUNE-JULY, 1942
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 38-0-0 per ton.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 50-0-0 to 115-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 84-9-0 to 93-12-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 72-0-0 to 130-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 1-2-0 to 1-6-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 11-8-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
,, ..	,, ..	Punjab ..	10′×10″×5″ ..	Rs. 7-14-0 per piece.
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	Rs. 40-0-0 to 45-0-0 per ton.
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 10-5-4 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	Rs. 80-12-0 to 84-10-0 per ton.
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	
Gurjan ..	*Dipterocarpus* spp. ..	Assam ..	Squares ..	Rs. 100-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 50-0-0 per ton.
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	Rs. 65-0-0 per ton.
,, ..	,, ..	Bombay ..	Squares ..	Rs. 40-0-0 to 80-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-10-0 to 1-0-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 61-7-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 1-8-0 to 2-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 0-14-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers ..	
Indian rose-wood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 70-0-0 to 160-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-4-0 to 1-8-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 103-2-0 to 197-2-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 93-12-0 to 109-6-0 per ton.
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 60-0-0 to 85-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 to 1-4-0 per c.ft

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-7-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 75-12-0 to 100-0-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 1-2-0 to 2-8-0 per c.ft
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 50-0-0 to 112-8-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-4-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-14-0 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 50-0-0 to 100-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 1-8-0 to 2-0-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers..	Rs. 6-0-0 each.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 1-8-0 to 2-8-0 each.
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-10-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-10-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 2-8-0 to 2-12 0 each.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 300-0-0 to 700-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 2-0-8 per c.ft
,, ..	,, ..	Bihar ..	Logs ..	Re. 1-4-0 to 1-8-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-4-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 40-0-0 per ton.
,, ..	..	Bihar ..	Scantlings ..	Rs. 0-8-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 1-10-5 to 3-2-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Scantlings ..	Rs. 50-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class..	Rs. 100-0-0 to 125-0-9 per ton.
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-10-0 to 3-12-0 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-1-9 to 5-2-10 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 100-0-0 to 151-2-0 per ton. C class.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 92-0-0 to 340-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers..	Rs. 6-0-0 each.

EXTRACTS

WOODLAND EQUIPMENT

In a recent book* Sir George Stapledon describes with wide knowledge and penetrating perspicacity the present state of farm land in England and Wales.

"In round numbers we have 16¼ million acres of land in a more or less neglected condition, and much of it absolutely derelict: and every single acre of this enormous area (no less than 43 per cent of the land area of England and Wales) is capable of radical improvement."

"An incredible state of affairs, this, for an island country with a huge population. The more disastrous because the state of the land has everywhere been matched by conditions equally deplorable in respect of farm facilities. Opinions will always differ as to the order in which the several items contributing to dilapidation, lack of facilities, and land dereliction should be placed in a scale of hindrance to high farming. I shall deal with these hindrances in the order which I consider fully justified by the evidence at my disposal—in a descending scale of seriousness."

Sir George's list of hindrances is as follows: (*i*) Lack of proper watering facilities. (*ii*) Lack of abundant and good rural cottages and water. (*iii*) Failure to keep fences stock-proof. (*iv*) Rabbit infestation. (*v*) Neglect of drainage. (*vi*) Dilapidated, inconvenient and out-of-date farm buildings. (*vii*) The poorness of farm roads. (*viii*) The deplorable condition of many farm-houses. (*ix*) Inconvenient lay-out of farms.

The reader is referred to the original book for the arguments with which the writer supports the rather surprising order in which these hindrances are placed. The list is interesting in itself and challenges foresters to produce a similar list for their own branch of husbandry. The list which each of us would suggest must vary with our experience and special interest and no list can be final, but any attempt to enumerate the hindrances to good woodland cultivation on estates will disclose a large number of similarities between agriculture and forestry and will lead us to realize how

* Make Fruitful The Land—A Policy for Agriculture. Kegan Paul, 1s.

many of the important obstacles to good forestry have been neglected in our recent discussions on forest policy. In the following list I have ventured to suggest nine of what appear to me to be the chief technical hindrances to good woodland management. Like those of Sir George Stapledon, they are placed "in a descending scale of seriousness."

(*i*) The paucity of good trees to serve as a basis for sustained yield (*ii*) Lack of sufficient good cottages for woodmen. (*iii*) Rabbit infestation. (*iv*) Lack of sufficient woodland roads. (*v*) Lack of lorries constructed for woodland work. (*vi*) Inconvenient lay-out of woods. (*vii*) High cost of maintaining woodland fences. (*viii*) Lack of woodland buildings. (*ix*) Neglect of drainage in woods.

Any attempt to justify the order in which these hindrances to good woodland management are placed or, indeed, to provide evidence to support their right to a place in the list would lead to a tedious repetition of old arguments. It will better serve our case to pick out the middle block and to discuss the physical equipment which is required for intensive management of woods—roads, lorries, fences, buildings and lay-out. War needs have brought many woods, which were previously neglected, under intensive felling schemes. It has become the duty of the woodland staff to secure timber, pit props, poles, pickets, cord-wood, fire-wood and even small thinnings as rapidly as possible and to pass them in an endless stream to rail-head, mill or local consumer. And if schemes have been carefully devised this can often be done without any wholesale destruction; indeed, the present is a wonderful opportunity for clearing up and putting under scientific management many of the areas which were too poor or too inaccessible to be worth serious attention in peace-time.

Living as we are in the grip of war necessity, any care and thought for the England which will remain after the war may appear misplaced or almost unpatriotic. The need for timber of all kinds is so urgent and the call on all labour which has any skill in woodcraft is so insistent that utter devastation may appear not only defensible but almost a duty. But this is a short-sighted view and in all woodlands where the owner or his staff have time to think

and plan such thinking and planning are called for more than ever before. And in this view we have the official backing of the Forestry Commission which not only urged us to be selective in our fellings especially in felling first those coniferous plantations which were either mature or were between 20 and 35 years, but has set us an example by itself maintaining its planting programme on a pre-war footing. It was early decided that the vast volume of home-grown timber, which would clearly have to be obtained during the war, should not be secured with the utter disregard for future woodland management which was so common during the last war. We wish we could be more confident that the Acquisition Officers of the Home-Grown Timber Production Department were paying as much attention to this principle as the national interest requires.

The most important part of the equipment of a wood is a system of roadways, and now, when large quantities of wood and timber have to be removed, money spent on roads may be rapidly repaid by economies in transport. This is most clearly evident where pit props are being cut as they nearly always have to be loaded on a lorry somewhere and if the lorry can gain access to the tushing points an additional loading and unloading are avoided. Roads are of equal value for the removal of other poles, for fire-wood and, indeed, for any product which can be loaded on lorries. They serve, too, for the removal of heavy timber if the timber extraction is controlled by the estate forester, but their use by timber merchants is not to be encouraged; merchants generally work with very heavy tackle and the requirements of their business force them to work in all weathers; woodland roads are not made for such reckless use.

When a forester is planning roads to economise the transport of his products he will naturally arrange that they shall be so disposed as to serve the future working of the woods and he will endeavour to construct the main arteries so that they shall be as permanent as is reasonably possible. Their character must be determined by the nature of the ground. In most cases they will be dirt tracks, which with suitable draining will be serviceable for about eight months in the year, but not more. Where stone is plentiful, however, some of them may be metalled so that they can be used at

all times. Good management will lead us to arrange fellings in such a way that the areas served by the good roads are worked in winter so that the muddier tracks need only be used in summer.

Except on steep or marshy ground the making of dirt tracks is usually a very simple process, but great care should be exercised in planning their lay-out. They should be so arranged that there are no unnecessarily steep gradients, though on hillsides they can sometimes be used for one-way traffic only the approach being from a road at the top of a hill and the exit at the bottom. Ditches and small streams may be crossed by culverts and to-day, when metal is scarce, wooden pipes made from squared timber (we call them "launders" in Devon) may be used instead. In middle-aged and old woods it is not necessary to cut more than a few trees in order to open up a track and the canopy need not be disturbed more than in an ordinary thinning, but in many casees it is worth while to have these trees out by the roots if a forest tractor with a winch is available. Good timber should be felled as far as possible in winter when it is impossible to use these tracks except for tushing, and most of the extraction should then be left until the following summer unless the ground is sufficiently hardened by frost.

The period in each year when dirt tracks can be used is greatly extended if suitable lorries can be secured for working on them. At present we cannot pick and choose so we have to work with what lorries are available, but after the war there will be a large variety of ex-army trucks to select from. It is possible that when we beat our swords into ploughshares and our spears into pruning hooks we shall turn Bren-gun carriers into high timber carriages, but so far the most efficient lorry seems to be a short wheel base six-wheeler with two driving axles and a supplementary gear box to provide an exceptionally low gear. The ideal vehicle has yet to be constructed and there is still scope for engineering research in designing it.

The chief use of woodland buildings is to provide wet weather work for the woodmen and their nature will depend on the kinds of work which they are intended to assist. Apart from saw-milling, which is too big an operation to confine to wet weather, the most important are likely to be manufacture of fire-wood and kindling, the preparation of stakes and hurdles and such other subsidiary

trades as the locality demands or the ingenuity of the forester devises. Sheds for such purposes are of great value in any large wood and a forester is fortunate if he can so arrange his road system that the tracks converge on to a public road at a point where his sheds can be built. Where there is a large market for fire-wood it will be found more economical to cut it in the wood as well as in the yard, especially if lorries can haul it direct from a felling operation to the customer, so the yard need not be so large as to meet all the needs of the estate.

A large wood may require more than one shed, especially if it has several exits on to public roads. On the other hand several small woods may be served by one shed. These sheds are cheap to build and can be moved without much difficulty, so they may be erected for temporary use and shifted to another site if the strategy of management so requires. This method applies particularly to woods which are being cleared and replanted; a shed is needed most of all during clearing but for some years after the planting it will serve no useful purpose except for the storage of tools, so its retention may not be justified; when, however, the new plantations reach the thinning stage a shed will again be required and it will continue to be needed till the end of the rotation. A large wood which always contains stands of various ages will provide constant use for a shed.

The lay-out of his woods is just as important to a forester as the lay-out of his fields to a farmer. Estate foresters are so accustomed to working small and scattered woods that they are apt to forget the extent to which this dispersion of units handicaps their activities. Their compensation lies in the fact that whereas large areas of woodland generally occur on soil which is too poor for agriculture these small woods are often on land of first-class quality which is preserved as woodland either for amenity or because of the steepness of the ground or some other very local feature. It is these small areas which provide the best land for ash and other fastidious trees, and when we use them for conifers we may gain through rapidity of growth what we lose through difficulty of management.

Just as the lay-out of farms can be improved by the interchange of fields so the lay-out of woodland estates can be improved

by the interchange of woods. A wood which is difficult for the owner to manage on account of its distance may fall within the ambit of easy control by another estate and the transfer of such woods should enhance the national efficiency of forest administration. Apart from this, minor improvements may be achieved by the rectification of boundaries so as to reduce the length of fences and facilitate transport.

The problem of fences has never been adequately dealt with in the text-books and there is room for an authoritative treatise on the subject. Many long-established estates have, like the railways, achieved a traditional routine of fencing which is extremely efficient but less experienced men—and improvement in rural equipment can only come through the training of more men—generally start with false economies which in the long run prove very expensive. What we need is a fence which is cheap to construct, lasting, easy to maintain and repair, and looks well. There would, however, be no unanimity among foresters or farmers as to which type of fence best stands up to these conditions. There is much to be said for the hawthorn hedge but it is expensive to form as it requires a stock-proof protection while it is young and as a woodland fence it has two disadvantages: it is liable to damage by the shade of trees and if broken through for the extraction of timber it is difficult to repair. Post and wire will probably form the basis of most new fencing around woodlands but the nature of the post and the cheapest means of preservation are still subjects for investigation, and a large volume of valuable information could be collected from well-managed estates if their operations were carefully costed.—*Quarterly Journal of Forestry*, Vol. XXXV, No. 3, dated July, 1941.

FORESTRY IN FRANCE TO-DAY

By C. M. Smith

"The tragic happenings which have befallen France compelled us to interrupt the regular publication of this magazine. We resume publication as speedily as circumstances permit. No matter what our present distress and despite all losses suffered by our country, it is important not to give way to despair. We must take a

grip on ourselves and work whole-heartedly for the reconstruction of a national economy. French forests have a large part to play in this reconstruction. New laws decree that professional groups of foresters will take a large part in the reorganization of forest production."

Technical French forest magazines are now irregularly finding their way to New Zealand. The above is the gist of an editorial from one of them written in the first six months after the occupation. There is a fairness of tone in it that cannot but evoke admiration: and the hope that before long, French foresters may be called on to apply themselves to a worthier reconstruction. Meantime, French forest tradition stands unaltered. In the depths of the gravest national disaster, the forests must not be ruined or neglected: nor must the forest capital be squandered. One wonders what disappointments are in store for such idealism.

What then of the forests? Decrees and regulations concerning forests have poured forth in an apparently endless stream. By the beginning of August, 1940—less than two months after France's tragedy—the Vichy Government decreed a 50 per cent. increase on the normal felling budget of all forests until further notice. All private owners had to render an inventory return of their holdings and forest stands within a month. By October, 1940, professional registration of everyone down to the humblest forest workman was instituted. No one without a current registration card—fee payable on registration and monthly thereafter to keep it current—could deal or work in forest produce. Maximum prices are fixed in the greatest detail. Oak must be barked and the bark sold for tanning, purchasers of oak being specially warned against objecting to this. All hardwood lop and top between 50 mm. and 60 mm. in diameter must be burnt for charcoal (chestnut and soft hardwoods excepted). Standard grades are defined for charcoal sold for producer-gas. Chestnut logs and billets over 20 cm. in diameter may not be used for firewood. All communal forests are to come under the "forestry regime" at once.

These are a few taken at random from the numerous decrees of the Vichy Government. To the forester, they appear to indicate a period of desperate overcutting. Coal and petrol are plainly

almost unobtainable. Every effort is being made to replace them with firewood and charcoal, to ration the supplies of these, and to restrict them both in price and in method of use.

"Pulpwood is a special cause for worry. Railway sleepers form another item for special attention. Constructional timber is in keen demand."

With such a state of affairs, it seems doubtful whether any regulations, however, severe, can regulate prices, and whether any professional skill and ingenuity can avert a holocaust of over-cutting. The traditional French 25 per cent. reserve must disappear very rapidly when a 50 per cent. increase of cut becomes mandatory.

But even in such a economic national crisis, the propaganda side of forestry receives attention. In November, 1940, an oak in the Forest of Troncais became the "Chene Marechal Petain": and the Marshal himself found time to be present. The dedicatory speech voiced the hope that just as careful management over many centuries has remade the forest of Troncais out of a 17th century ruined jungle, so may a vigorous and sane France be rebuilt by careful management. All foresters who know Troncais—and they are many—will concur in this hope whole-heartedly but it may be that their prescriptions for the new working plan would differ widely from those of the dedicating official. There are many honorary freemen of Troncais who would welcome a chance of carrying out the "coupes d'amelioration" that will be necessary before a rational working plan can be put into operation in France. —*The New Zealand Journal of Forestry*, Vol. IV, No. 5, dated 1940-41.

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INDIAN FORESTER

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TIMBER ROOF TRUSSES WITH SOLID WOODEN DISC DOWELS, AND REPORT ON TESTS ON TWO TRUSSES OF 40 FT. SPAN.

BY V. D. LIMAYE, B. E. (MECH.),

Officer-in-Charge, Timber Testing Section

Forest Research Institute, Dehra Dun

SHORTAGE OF STEEL

Whatever steel is produced in India has nowadays to be very strictly rationed for the most urgent purposes. Army building programmes, on the other hand, have expanded enormously owing to constructural work connected with the war. Sheds, godowns, huts, prisoners' camps, barracks, factories and other buildings are springing up everywhere in India and there is a great demand for large quantities of structural material. Steel would ordinarily have been used for a large part of these buildings if it was available. But as it is not, military engineers and others are looking for a good substitute. Wood is a building material worthy of more serious consideration than it has been given in the past.

TIMBER A MOST LOGICAL MATERIAL

There are several advantages in using timber for structural work. They are as follows:

(1) Timber can usually be obtained locally without difficulty in most parts of India.

(2) It does not require very complicated machines and tools to work it.

(3) It does not require highly trained mechanics and fitters to work it.

(4) It can be easily framed into structures by the use of suitable joints.

(5) Timber structures can be erected very quickly.

(6) Its cost is comparatively low. A dowel timber roof truss, for example, can be manufactured at about one-quarter the cost of steel and one-half the cost of the older types of wooden truss if scientifically designed.

(7) Timber structures are easily removable and can be re erected and repaired very easily.

(8) Timber, if effectively treated, can be protected against insect pests and rot. The more important structural timbers of India such as teak, *sal, deodar, sissoo, babul, bijasal, hopea, irul* and others are naturally durable for a considerable period against insects and rot, and timber structures would last indefinitely if the same care is given to them as is given to steel.

To sum up, timber is a most logical material for structural work. It only requires a proper understanding of its physical and mechanical properties and an intelligent use of these in the most advantageous way.

THE OLD AND THE NEW

Let us consider a roof truss for a shed of 40 feet span. There are three alternatives :

(1) A roof truss made completely of steel.

(2) A roof truss made of timber with steel gusset plates, straps and bolts, on the same lines as those for a steel truss.

(3) A roof truss made completely of timber with solid wooden disc dowels and only a small number of bolts.

(1) *Steel truss.*—A steel truss of the standard design for a span of 40 feet would weigh about 1,100 lbs. and would cost, at the present rate of steel, at least Rs. 300 for material and Rs. 75 for labour. The total cost of one truss works out, therefore, at about Rs. 375 per truss. It also requires special machine tools and trained personnel. If a steel truss is made in a factory away from the site of erection, as it usually is, extra expense will be incurred on freight and carriage.

(2) *A timber truss with steel gusset and strap joints.*—A 40-ft. roof truss of this type (the type most commonly used) would require about 22 cubic feet of timber, 224 lbs. of steel and 85 lbs. of bolts and nuts.

	Rs.
Cost of 22 cubic feet of sal timber @ Rs. 2/8/- cubic foot	55
Cost of 224 lbs. of steel @ Rs. 30 cwt.	60
Cost of 85 lbs. of bolts and nuts @ Rs. 70 cwt.	55
Cost of making	30
Total	200

(3) *A timber truss with solid wooden disc dowels.*—A 40-ft. roof truss made of timber only with solid wooden disc dowels, would require only 21 cubic feet of timber, 100 wooden disc dowels, 23 lbs. of bolts and nuts and no steel.

	Rs.
Cost of 21 cubic feet of sal timber @ Rs. 2/8/- cubic foot	53
Cost of 100 solid *babul* disc dowels @ Rs. 12 per 100	12
Cost of 23 lbs. of bolts and nuts @ Rs. 70 per cwt.	15
Cost of making	20
Total	100

COMPARATIVE COST AND SAVING

The following table gives the details of each type for comparison:

Material	Steel truss		Timber truss with steel gussets and straps		Timber truss with wooden disc dowels	
	Quantity	Cost Rs.	Quantity	Cost Rs.	Quantity	Cost Rs.
Timber	..	..	22 cu. ft.	55	21 cu. ft.	53
Steel	1,100 lbs.	300	224 lbs.	60	..	..
Solid babul disc dowels ..	..	..	..	..	100 Nos.	12
Bolts and nuts ..	..	..	85 lbs.	55	23 lbs.	15
Making	..	75	..	30	..	20
Total weight ..	1,100 lbs.	..	1,625 lbs.	..	1,285 lbs.	..
Total cost	Rs. 375		Rs. 200		Rs. 100	

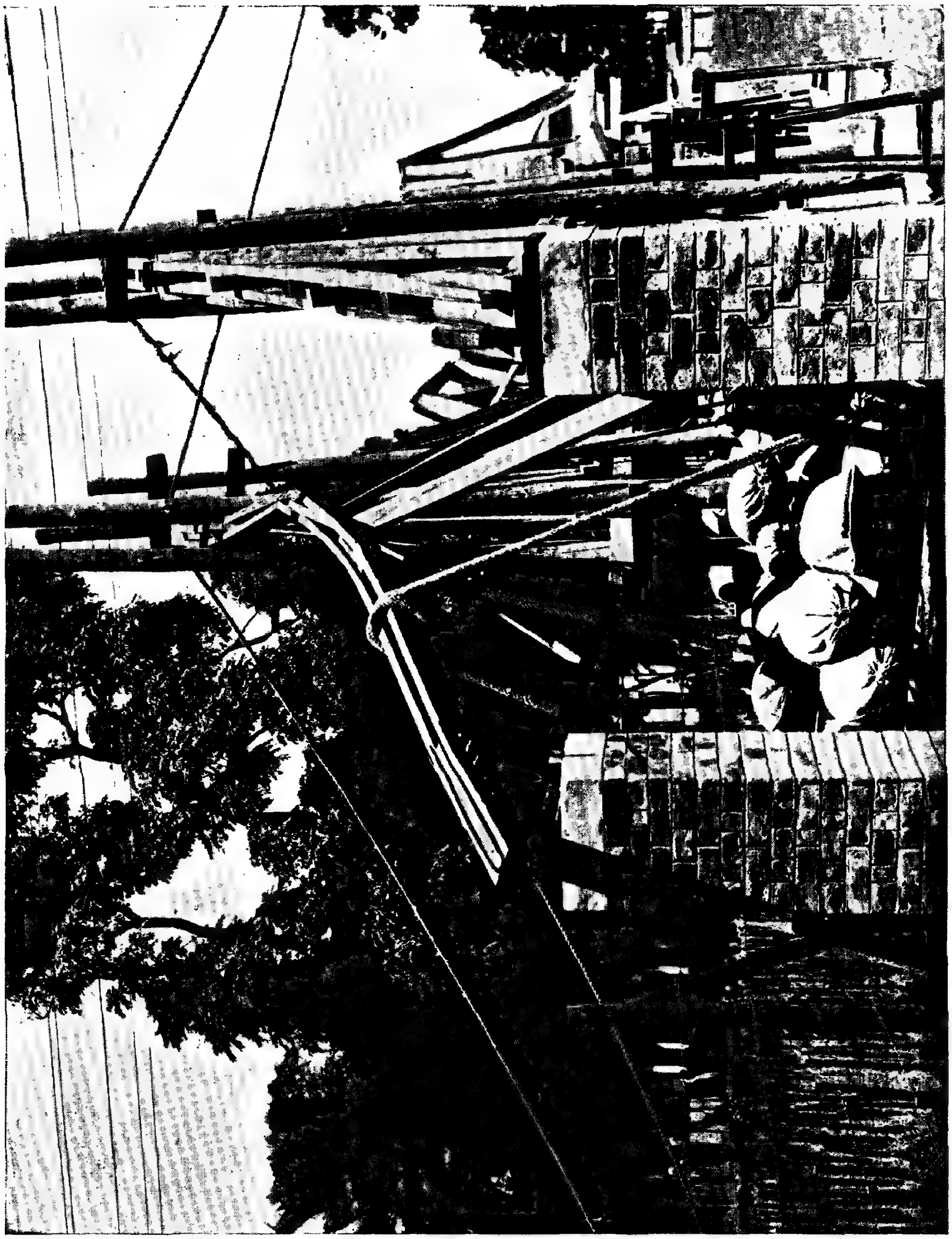
It will thus be seen that the adoption of the dowel truss would not only dispense with the use of steel, but would also cost less and save Rs. 100 per truss over the standard pattern timber truss with gusset plates.

THE SCIENTIFIC ASPECT OF THE WOODEN DISC DOWELS

Timber roof trusses and in fact all timber structures are usually designed on the same lines as the designs of steel structures and joints are made without paying much attention to the fundamental differences in the strength properties of the two materials. In fact the properties of timber were formerly not very clearly understood until scientific testing of timber was developed. In the case of steel the shearing strength is about 4/5th of the tensile strength, while in the case of timber it is only about 1/15th of the tensile strength or even less. While designing timber structures this fact must be clearly borne in mind. As joints are the weakest parts of any structure, it is usually the practice to put heavy steel gusset plates and bolts to transmit the loads from one member of the structure to another. Timber always fails by shearing or crushing in front of the bolt. The function of disc dowels (which are incorporated into the joints) is to distribute the shearing stress on a larger area so as to transmit the full amount, or as large a portion as possible, of the stresses in the members meeting at the joints. In this way no gusset plates and straps are required as sufficient resisting stress is developed in the member itself. The bolts only serve to keep the different members meeting at the joints together and they carry very little stress. They come into play only when the joints begin to give way or the disc dowels themselves shear. As the efficiency of joints is increased considerably by the use of disc dowels, economy is effected by having to use less timber and practically no metal.

DEMONSTRATION OF THE PRINCIPLE OF DISC DOWEL JOINTS

The Surveyor of Works, Eastern Command, the Commander, Royal Engineers, Meerut District Headquarters, and a military contractor's engineer paid visits to the Timber Testing Laboratory in March 1942 when it was explained how it was possible to build a timber roof truss without using any steel gusset plates and straps and with only a small number of bolts. The principle of making structural joints with wooden disc dowels was also demonstrated



Showing the failure of the M. E. S. pattern truss with steel gusset plates and straps. Total load on the truss at failure is only $3\frac{1}{2}$ tons which is only about 75% of the designed load.

by actual test results. As, however, this type of construction is not, at present, in vogue in Indian engineering practice, the C. R. E. wanted full-scale tests made before considering the adoption of timber trusses built with wooden disc dowels.

Two 40-feet trusses of sal wood were, therefore, built near the Timber Testing Laboratory of the Forest Research Institute, by his contractor, for testing. The construction was intentionally given to the army contractor in order to obtain the same kind of material and labour as would be employed in actual military works.

One truss was made according to the design prepared by the Officer-in-Charge, Timber Testing Section, using solid wooden disc dowels. The other truss was constructed with steel gusset plates and straps according to Drawing No. 972, sheet No. 2 (*a*) provided by the military authorities. This is one of the standard types of trusses in use by the Military Engineering Service. Dowels of 4 inches and 3 inches in diameter, 1 inch thick, were used in the dowel truss. Although *babul* is the best timber for making dowels, it was not readily available in the local market. *Sissoo* was, therefore, used for making the dowels. Both the trusses were erected side by side on brick masonry pillars 18″ × 18″, and 5′-6″ high.

TESTING OF TWO LARGE 40 FT. TRUSSES

The truss with the dowel joints was tested on the 13th April, 1942. The military pattern truss with steel gussets and straps was tested on the 18th April, 1942 after it had been inspected by the Garrison Engineer. Loads were applied at each of the seven panel points of both trusses by hanging cement bags from the principal rafters as seen in the photograph in plate 27. The initial load at each panel point was 2 cwts. This was increased by adding 2 cwts. at each point successively until 20 cwts. was attained at each point of the dowel truss, thus making a total load of 7 tons for the truss. This represented a load about 50 per cent. greater than the designed load. In the case of other truss, a total load of only $3\frac{1}{2}$ tons could be applied as it broke and collapsed at that load. This load represented only about 75 per cent. of the designed load.

The superiority of the dowel truss was, therefore, very clearly indicated in this practical trial which was witnessed by the C.R.E. and several military and civil engineers. Drawings, and specifications were at once asked for and information has since been received that wooden disc dowel trusses are to be adopted immediately in some pending military constructional work and also in constructions being erected by the Public Works Department.

STUDIES IN CLIMATIC CHANGE—II

(Amelioration, by Contour Trenching arid hill forest slopes)

BY W. D. M. WARREN, I.F.S.

CHAIBASSA'S CLIMATE

Chaibassa is an all-India Meterological station keeping temperatures and relative humidities, as well as rainfall and rainy days. It is 14 miles from the nearest point of the trenching system, above Roro, but as there is only one continuous trench there and the contour is not so tortuous, with fewer spurs and re-entrant valleys, the influence on this side is perhaps not quite so strong. It is 20 miles from the main system on the Bamiaburu plateau. Its rainfall and rainy day statistics are as follows:

Month	Rainfall			Rainy Days		
	Normal	Average 1936-39	Difference	Normal	Average 1936-39	Difference
January ..	0·64	0·58	(—)0·06	1·3	0·75	(—) 0·55
February ..	1·49	1·77	0·28	2·4	4·75	2 35
March ..	1·00	0·37	(—)0·63	2·1	1·00	(—)1·10
April ..	1·25	0·61	(—)0·64	2·5	1·00	(—)1·5
May ..	3·23	3·45	0·22	5·8	7·25	1·45
June ..	8·76	10·75	1·99	11·7	11·50	(—) 0·2
July ..	12.09	11·43	(—)0·66	15·4	16·25	0·85
August ..	11·47	12·00	0·53	16·4	15·50	(—)0 9
September ..	8·05	6·51	(—)1·54	11·4	12·75	1·35
October ..	2·94	4·53	1·59	4·0	7·00	3·0
November ..	0·70	0·00	(—)0·70	1·0	0·00	(—)1·0
December ..	0·18	0·00	(—)0·18	0·4	0 00	(—)0.4
Total ..	51·80	52·00	0·2	74·4	77·75	3·35

As with Goilkera, the total rainfall for 1936-39 is practically normal, being 0.2 inches up. The distribution, however, shows a decided improvement on the normal and is better than Goilkera.

with gains of 0.22 inches in May, 1.99 inches (same as for Chakradharpur) in June, a slight deficit monsoon period (less in September but July and August practically cancelling out) and an increase of 1.59 inches for October. February again shows an increase of 0.28 inches. In fact, but for the gains at both ends of the monsoon the total rainfall would have been in deficit by 3.7 inches! The rainy days have increased by 3.35 which is poorer than Chakradharpur and Goilkera. February, May (not June!) July, September and October sharing the increase.

Temperatures and Relative Humidities

We next examine the relative humidities and temperatures for Chaibassa, information which was not available for the other stations. They are noted below and are interesting:

Month	Humidity			Maximum and Minimum Temperatures in °F.					
	Normal	Average 1936—39	Difference	Normal		Average 1936—39		Difference	
				Max.	Min.	Max.	Min.	Max.	Min.
January ..	83	76·7	(—)6·3	79·0	52·6	80·1	52·8	1·1	0·2
February ..	76	78	2	84·4	57·1	82·3	58·8	(—)2·1	1·1
March ..	61	65	4	94·5	65·1	95·4	66·6	0·9	1
April ..	58	63	5	102·4	74·6	102·4	76·0	..	1·4
May ..	63	69	6	104·2	79·1	102·9	79·2	(—)1·3	0·1
June ..	74	75·5	1·5	96·6	79·0	94·6	78·2	(—)2·0	(—)0·8
July ..	84	85	1	89 8	77·5	88·5	77·5	(—)1·3	..
August ..	86	86·5	0·5	88·5	77 0	88·3	77·1	(—)0·2	(—)0·1
September ..	85	85 5	0·5	89·5	76·0	88·7	75·3	(—)0·8	(—)0·7
October ..	81	81·5	0·5	88·7	70·0	87·5	71·1	(—)1·2	1·1
November ..	80	74	(—)6	82·7	59·7	79·0	59·6	(—)8 7	(—)0·1
December ..	84	77	(—)7	73 1	51·4	78·6	51·9	0·5	0·5
Total ..	76	76·5	0·5	89 9	68 3	85·0	70·2	(—)4·9	1·9

We see interesting relative humidity rises of 2, 4, 5 and 6 points for February, March, April and May, a smaller rise of 1.5 points for June, and a one-point rise for July, with only half-point rises for August, September and October, as might be expected. There are, however, big decreases for November, December and January! The greatest gains in humidity occur in the hottest months when evaporation and transpiration are greatest. The gains are smaller for the monsoon when humidities everywhere are normally high, while decreases are recorded in the cold weather when evaporation is least. A possible explanation of the decrease may be that soil temperatures as well as air temperatures are now cooler in the cold weather than formerly, and so less evaporation takes place. The sudden drop of 2.1 degrees F. in the maximum temperature of February seems out of keeping with the rises for January and March but perhaps can be explained by the increase in rainfall during that month. April shows no difference from normal but May is cooler by 1.3 degree F. and June by 2 degrees F.! July is cooler by 1.3 degree F., August and September by smaller amounts, but October by 1.2 degree F. and November by 3.7 degrees F.! December is warmer by half a degree!

Generally speaking, the maximum temperatures are cooler, throughout from May until November, with the biggest differences showing in May, June, October and November, the winter months December to March are warmer except for February, while April is normal.

The minimum temperatures on the whole are warmer than normal, the only cooler temperatures being in June—0.8 degree F., September—0.7 degree F., and November—0.1 degree F. The diurnal range of temperature is, therefore, less than normal, a result one would expect with the increased humidity of the atmosphere.

CHAKRADHARPUR'S IMPROVEMENT VERSUS CHAIBASSA'S

It may be asked, why Chakradharpur's climate has improved more than Chaibassa's, seeing that it lies sixteen miles from the nearest point of the experiment, against fourteen for Chaibassa from the weaker trench system of the Roro valley and twenty from

the main system. The answer, I suggest, is to be found in the closer proximity of the Saithba hills 2,500 ft. high to Chakradharpur, than to Chaibassa, and the confined space of the valley, stretching down from beyond Sonua, to the east past Chakradharpur. The width of the valley is about ten miles at Chakradharpur.

Cooler humidified air would flow down this valley at night, and being confined, would be less diffused than the cooler air of the Roro valley moving down towards Chaibassa. The nearness of the Saithba hills—the nearest outlier hill is only three miles away—would, under disturbed Meterological conditions also precipitate the excess moisture more easily.

Summary and Discussion

Improved distributon of rainfall with its concomitant increase in the number of rainy days, at both ends of the monsoon, in May, June and October, is the key to the climatic improvemet which has taken place in the 1936-39 cycle of these four stations.

This improved distribution is also linked up with a really remarkable increase in the average annual rainfall for Sonua the nearest station to the experiment, and a useful increase for Chakradharpur.

Even Goilkera which records the least signs of change, shows better distribution in the increased number of rainy days. An annual increase of eight and a half rainy days is not to be despised.

Of deep significance is the fact that the improved climate is not only measurable but substantial even sixteen miles from the experimental area at Chakradharpur. Climatologists criticising my earlier analysis* have warned me particularly, not to stress apparent changes in Chaibassa's climate, for instance, until the changes had been proved, as, in the words of one of them," I doubt if the improvement is measurable even up to ten miles from the forest edge."

Consequently, while drawing attention to the significance of these apparent climatic changes outside the forest, it would be premature at this stage to claim proof for anything herein analysed. Nevertheless, the fact that changes detected and reported on earlier have successfully survived a complete climatic cycle, is to my mind of great importance.

* Report for Silvicultural Conference 1939.

Let us look again at the gains in rainfall and the totals for the months of May, June and October for the four stations under review. They are impressive.

Average Gains in Rainfall for 1936-39

Stations		May over 1932-35	Over Normal	June over 1932-35	Over Normal	October over 1932-35	Over Normal
Sonua	..	2·22	0·86	7·13	4·23	2·74	0·87
Chakradharpur	..	..	2·12		1·99		2·24
Chaibassa	..	..	0·22		1.99		1·59
Goilkera	..	..	0·2		0·07		(—)0·19

Average Monthly Totals for 1936-39

		May	June	October
Sonua	...	3.52	12.10	3.96
Chakradharpur	...	5.29	11.24	4.77
Chaibassa	...	3.45	10.75	4.56
Goilkera	...	2.47	10.12	3.81

Benefit to Agriculture

From close personal observation, it can be said that the May rainfalls in the locality are usually not isolated showers, but are generally part of the transition period which gradually deepens, though not always without a check, into the full monsoon of July and August.

As soon as the first showers fall towards the end of May (in 1937 after two earlier showers they fell every day at Bamiaburu from the 15th onwards!) the ryot ploughs his lands and prepares to sow his paddy. Thus, with useful rains in May and good 10-12 inches in June, he has had in the locality and period under review at least the full four months of June to September for growth, with late varieties continuing into October.

That these early rainfalls can survive a drought year, was well illustrated in 1938. The locality's 10-12 inches in May and June, though less than normal enabled the paddy to be sown at the usual time whereas at Netarhat (Ranchi Plateau), sowings were only

being made in the last week of July, and in North Bihar were delayed even till early August. Although the total rainfall at Chaibassa was only 38 inches, that year, 14 inches below normal, timely rains just when drought threatened enabled the crop to continue without much check to growth to give nearly a normal yield. In less favourable localities the chief danger of delayed rains is that the monsoon may finish before the crop has had time to grow sufficiently to give a decent yield. The upland rice fails altogether.

The value of adequate rain in the early days of October is well known. It enables the paddy to put an extra length of straw, and to produce heavier yields of grain. In local parlance, it turns "a ten-twelve-anna crop into a sixteen-anna one." Moreover, good rainfall then, the last kick of the monsoon, enables the ryot to sow his *rabbi* crop of pulses with some hope of getting good yields.

To sum up, the ryot's prosperity is intimately bound up with early arrival of the monsoon and its prolongation into October. A normal rainfall, well distributed from May until October, is much better than much heavier rains concentrated in July and August. If the last four-year cycle is any criterion, famine has now been banished from the locality.

The ryots' point of view has been emphasized first because it is Government's primary duty to safeguard him. With India's population increasing so rapidly, with so many more mouths to fill—fifty million more in the last ten years—Government's anxiety for the ryot's welfare is bound to increase! Agriculture being the chief industry of India and the chief means of support for this growing population, the need for a stabilised or improved climate needs no emphasis.

Consequently, if we can show that a strong vigorous policy of forest improvement gives the ryot additional climatic safeguards, we are likely to receive more encouragement from Government than if the benefits extend only to forests themselves.

Benefits to Forestry

The benefits to the local forests surpass all expectations. The earlier arrival of the transition period with its frequent rains has saved the newly fallen sal seeds from perishing, and has created favourable conditions for their germination and survival. Sal

seedlings have not died out, or often even died back, the following hot weather and "blank" areas, blank for years if not centuries, are infilling rapidly with regeneration. The new Forest crop under the more favourable climatic conditions will probably remain sound now, up till their economic exploitable diameter, while close to the trenches the quality may improve to our second best with an economic improvement of seventy-one times! If the climatic improvement can extend to sixteen miles *outside* the forest, it should extend to at least that distance *inside* it, which would bring more than half the division under the improved climatic influence of this one experiment at the cost of only about Rs. 15,000 or £1,200!

Oecological quadrants later will give us precise results of infilling of regeneration and succession of plant life up to six miles from Bamiaburu, but perhaps even our controls twelve miles away will benefit as well!

Thus, expenditure on schemes of this nature confers a double benefit on the forests themselves and on the locality in the immediate vicinity at least.

Chances of proving climatic changes

Climatologists have already said that there is no question that contour trenching brings about a climatic improvement within the forest itself. Where they have counselled caution, is to claim success too soon for indications of climatic improvement outside the forest. In spite of this advice it does seem necessary to emphasize that the experiment has survived a full climatic cycle.

It has survived a year of drought, 1938. Only two worse years than 38 inches of rain at Chaibassa have been recorded since 1851, that *is in ninety-one years, and those were 34 and 33 inches respectively. So nature can scarcely have much worse in store for* us in total rainfall than has already been experienced in the cycle under review! It has also survived a rainless May in 1939, rainless in Chakradharpur, below 0.1 of an inch in Goilkera and Chaibassa, but 1.23 inches at Sonua (note Sonua's rainfall was that due to the experiment!), The previous rainless May in 1935 was completely rainless in all four stations! Is that a good omen too for the experiment?

Again, the full climatic influence the trenched area can exert will not be realized until the new regenerated forests have grown up to full closed canopy, so we may reasonably expect even better climatic figures in the future than we have had during this first climatic cycle.

Consequently, though judgment should be reserved on the experiment's value outside the forest area, until climatologists themselves agree that we have furnished proof, yet the chances that we shall prove it, and within a comparatively short time too, are favourable.

If we do, if we prove the influence even up to fifteen miles into the open, we shall have proved that we can change the whole of Chota Nagpur's climate as there are no forest-clad hills in Chota Nagpur more than 30 miles apart! The very thought staggers the imagination. What a change that would bring to the ryots prosperity! Millions of people would be lifted above the border line of poverty and semi-starvation!

P.S.—My thanks are due to Mr. Derry, Forest Research Officer, Bihar, for kindly furnishing me with the climatic data, upon which this analysis has been made. The figures for Sonua, which are so interesting and so important, have also been counter-checked and found correct by my office from data obtained from an independent source.

ECOLOGICAL SUCCESSION IN GRASSLAND

By N. P. Mohan, I.F.S.

Summary.—Based on general observations and annual yield figures, it appears that in Nurpur (Kangra district) *Themeda anathera, Cenchrus ciliaris and Chrysopogon montanus* are lower in the scale of succession than *Dichanthium annulatum, Bothriochloa pertusa and Heteropogon contortus.*

Introduction.—Study of plant ecology has not developed in the Punjab to the extent a student of vegetation might have wished. Observations of ecological succession in grassland, though comparatively easier, have not made much progress either. Of late the Standing Provincial Fodder and Grazing Committee has interested itself in the ecological succession in grasslands and some progress may now be confidently expected. This article summarises the

results of such observations carried out in a manner which is easier of practical application than the standard orthodox ecological technique of mapping the vegetation.

Details of trials and observations.—In the compound of an abandoned dak-bungalow at Nurpur, situated on a small hillock, locally known as *Suli Tila* (the hillock of the scaffold), efforts were made in 1937 to cultivate grasses. Nurpur is situated in Kangra district, at an elevation of about 2,000 feet with an annual rainfall of 54 inches (average of last five years).

The soil is thin, generally less than a foot in depth. Underlying rock is sandstone. The slope is gentle to moderate. The original grass vegetation was very sparse, the compound being open to grazing. The common grasses of the locality *viz. Chrysopogon montanus,* Trin.; *Dichanthium annulatum,* Stapf.; *Heteropogon contortus,* Roem and Schult.; *Bothriochloa pertusa,* A. Camus; *Themeda anathera,* Hack. were represented.

The compound was closed to grazing in 1937 and contour trenched in 1938 and divided into fields. 3 *chhataks* (6 ozs.) of nicifos manure was added to each trench. Different fields were sown or planted with different species. Berms of trenches in one plot were planted with rhizomes of *Sorghum halepense,* Pers. In the first year, *Cassia tora* appeared in great abundance along the berms and centres. (This was a temporary phase. *Cassia tora* has become progressively less with the increase in grass.) The species sown were *Dichanthium annulatum,* Stapf.; *Heteropogon contortus,* Roem and Schult.; *Chrysopogon montanus,* Trin.; *Cynodon dactylon,* Pers.; *Apluda aristata,* Linn.; *Cenchrus ciliaris,* Linn.; *Cymbopogon martini,* Wats.; *Leptochloa dubia, Tricanthos annulatus* and *Themeda anathera,* Hack. It was soon observed that the different fields could not be kept pure though the dominant grass in each field was the one sown in each field.

In 1939-40 sub-plots under *Cymbopogon martini, Leptochloa dubia, Tricanthos annulatus, Themeda* and *Sorghum halepense* (this species in another plot was, however, successful) were abandoned as the crop was too poor to warrant further work and sown with *Dichanthium annulatum.* In tending operations no grass was uprooted to favour any particular species of grass. Rank weed growth was pulled out twice during the rains but no leguminous plants

were removed. History of each field, its present condition and grass yield by species are briefly summarized below:

FIELD No. 1.—Area 10,373 sq. feet. Sown with *Cenchrus ciliaris* in July 1937 and blanks again in 1938. *Dichanthium annulatum, Chrysopogon montanus* and *Heteropogon contortus* have come in naturally. Due to shallow and poor nature of the soil the invasion has not resulted in *Cenchrus ciliaris* being completely ousted. It is still abundant.

Yield in 1937, 1938 and 1939 was a mixed one with dominance of *Cenchrus ciliaris*. There was a marked change in composition in 1940, invasion by other grasses being pronounced. In 1941 the yield was composed of *Dichanthium annulatum* (3 maunds 30 seers or 300 lb.), *Cenchrus ciliaris* (2 maunds 22 seers or 204 lb.), *Heteropogon contortus* (19 seers or 38 lb.), and *Chrysopogon montanis* (17 seers or 34 lb.).

FIELD No. 2 (*i*).—Area 2,648 sq. feet. Contour trenched and sown in July 1939 with *Dichanthium annulatum*. Soil poor and dry. It contains a pure crop of the species without any mixture of any other grass. Yield of *Dichanthium annulatum* only in 1939, 1940 and 1941 (3 maunds 17 seers or 274 lb.).

FIELD No. 2 (*ii*).—Area 728 sq. feet. Stocks with tufts of *Cynodon dactylon* in July 1937. As may have been expected *Cynodon dactylon* has not remained the dominant grass as the successful cultivation of this grass requires a special technique. The plot has been invaded by *Bothriochloa pertusa* while *Cynodon dactylon* is badly suppressed. *Apluda aristata* has appeared on the *pattri* of the contour trench.

Yield in 1938, 1939 and 1940 was a mixed one with little of *Cynodon dactylon*. Only 3 seers (6 lb.) of *Cynodon* were available for cutting in 1941 and the yield was composed of *Bothriochloa pertusa* (13 seers or 26 lb.) and *Apluda aristata* (4 seers or 8 lb.).

FIELD No. 3.—Area 4,882 sq. feet. Sown in July 1937 with *Dichanthium annnulatum*. Blanks resown in 1938. The plot now contains a pure crop of the species sown with a few scattered clumps of *Heteropogon contortus*.

Yield throughout of *Dichanthium annulatum*. In 1941, the yield was 8 maunds 10 seers (660 lb.).

FIELD No. 4 (*i*).—Area 1,767 sq. feet. Sown in July 1937 with *Heteropogon contortus* and blanks resown in 1938. *Apluda aristata* has appeared in mixture over half of the plot but *Heteropogon* is dominant over the whole plot.

Yield from 1938 onwards principally of *Heteropogon contortus*. The 1941 yield was composed of $3\frac{1}{2}$ maunds (280 lb.) of *Heteropogon contortus* and 32 seers (64 lb.) of *Apluda aristata*.

FIELD No. 4 (*ii*). Area 1,732 sq. feet. Sown in July 1937 with *Dichanthium annulatum* and blanks resown in 1938. The plot contains an almost pure crop of the species sown with a little mixture of *Apluda aristata* over a part of the plot.

Yield throughout principally of *Dichanthium annulatum*; in 1941 *Dichanthum annulatum* 3½ maunds and *Apluda arstata* 18 seers.

FIELD No. 4 (*iii*).—Area 1,417 sq. feet. Sown in July 1937 with *Cenchrus ciliaris* and blanks resown in 1938. *Cenchrus ciliaris* has been almost entirely replaced by *Dichanthium annulatum* and *Apluda aristata*, the former in the centre and the latter on the pattris of contour trenches.

Mixed yield throughout. In 1941, the yield was composed of *Dichanthium annulatum* (2 maunds 7 seers or 174 lb.) and *Alpuda aritata* (1 maund 19 seers or 118 lb.).

FIELD No. 5.—Area 4,755 sq. feet. Sown in July 1937 with *Dichanthium annulatum* and blanks resown in 1938. The plot has a dominance of this species with *Apluda aristata* on the *pattris* and in a strip.

Yield was composed of *Dichanthium annulatum* with a varying proportion of Apluda aristata from 1939 to 1940. In 1941, *Dichanthium* was 12 maunds 6 seers (972 lb.) and *Apluda* 1 maund 27 seers (134 lb.).

FIELD No. 6.—Area 5,911 sq. feet. Sown in July 1937 with *Cenchrus ciliaris* and blanks resown in 1938. The change in this plot has been very striking. Starting with an almost pure crop of *Cenchrus ciliaris*, now no part has a pure crop of this species. *Dichanthium annulatum*, *Rotboella exaltata* and *Apluda aristata* have invaded the area, the first one being the dominant.

Yield was a mixed one from 1937 to 1940, when the proportion of *Cenchrus* markedly became less. The year 1941 gave 4 maunds 24 seers (368 lb.) of *Dichanthium annulatum*, 2 maunds 2 seers (164 lb.) of *Rotboella exaltata*, 2 maunds 9 seers (178 lb.) of *Apluda aristata*, 20 seers (40 lb.) of *Heteropogon contortus*, 18 seers (36 lb.) of *Cenchrus ciliaria* and 5 seers (10 lb.) of *Chrysopogon montanus*.

FIELD No. 7.—Area 10,299 sq. feet. Stocked with *Sorghum halepense* rhizomes in 1938 and blanks restocked in 1939. *Sorghum* has been successful in scattered places over about 1,400 feet. The plot has been invaded by *Bothriochloa pertusa* and *Apluda aristata*.

Yield was a mixed one in 1938 to 1940. In 1941 it was composed of *Bothriochloa pertusa* 16¼ maunds (1,300 lb.), *Sorghum*

halepense 9 maunds 2 seers (724 lb.) and *Apluda aristata* 1 maund 22 seers (124 lb.).

FIELD No. 8 (*i*).—Area 1,301 sq. feet. Sown in June 1938 *Cenchrus ciliaris,* resown in July 1939. *Cenchrus* has been very badly suppressed by *Bothriochloa pertusa* and *Apluda aristata,* while over a part of the plot some *Heteropogon contortus* has also appeared.

Yield was a mixed one throughout. The figures for 1941 are *Bothriochloa pertusa* 35 seers (70 lb.), *Apluda aristata* 23 seers (46 lb.), *Heteropogon contortus* 14 seers (28 lb.) and *Cenchrus ciliaris* 12 seers (24 lb.).

FIELD No. 8 (*ii*).—Area 1,473 sq. feet. Sown with *Apluda aristata* in 1938. Dominant crop is still *Apluda* though *Heteropogon contortus* and *Bothriochloa pertusa* have invaded the plot, the former from the north and the latter from the south.

Mixed yield with dominance of *Apluda.* The 1941 yield was composed of 2 maunds 13 seers (186 lb.) of *Apluda,* 32 seers (64 lb.) of *Bothriochloa pertusa* and 15 seers (30 lb.) of *Heteropogon contortus.*

FIELD No. 8 (*iii*).—Area 2,328 sq. feet. Sown with *Chrysopogon montanus in 1938.* Dominant crop now is *Bothriochloa-pertusa* with *Apluda* mixed. *Chrysopogon montanus* is scattered but is left behind in the struggle. There are a few clumps of *Themeda anathera.*

Mixed yield from 1938 onwards. The figures for 1941 are 1 maund 18 seers (116 lb.) of *Bothrochloa pertusa,* 1 maund 20 seers (120 lb.) of *Apluda aristata* and 29 seers (50 lb.) of *Chrysopogon montanus.*

Succession.—The years 1937, 1938 and 1939 were spent in stocking and re-stocking the fields with different grasses; they came into full bearing in 1938 and 1939 when the yield was principally composed of species sown; in 1940 a change in the composition of plots was observed and it was decided in 1941 to separate out the yield by species and thus determine the successional changes. The mapping of vegetation was not attempted as it would not give quantitative results (by weights) of yield of different grasses. From a practical point of view, it was more important to know the total yield

in maunds and composition of that yield by different species. Grass yield being annual, any change in the composition and vigour would be reflected in the yield figures of species. It was therefore decided to separate out different species of grasses at the time of cutting and weigh them separately. The results have been given above field by field.

Total yield.—The total yield from different plots which is a cumulative effect of closure, contour trenching, application of fertilizer, sowings and changes in succession are tabulated below:

Field No.	Calculated yield per acre in maunds. Only one cut.				
	1937	1938	1939	1940	1941
1 ..	20	26	43	34	30
2(*i*) ..	..	..	12	55	56
2(*ii*) ..	29	31	46	49	30
3 ..	27	46	108	87	74
4(*i*) ..	33	79	108	129	106
4(*ii*) ..	47	83	116	129	99
4(*iii*) ..	28	29	94	105	112
5 ..	25	46	140	121	127
6 ..	29	33	53	60	73
7 ..	..	57	110	97	114
8(*i*) ..	..	34	79	63	70
8(*ii*) ..	..	48	81	75	104
8(*iii*) ..	..	27	66	68	69

Discussion and conclusions.—*Cenchrus ciliaris* was sown in field Nos. 1, 4(*iii*), 6 and 8(*i*) and in no plot has it been able to maintain its dominance; in fact it has completely disappeared in one plot, while in others it is being suppressed. The chief invader has been *Dichanthium annulatum,* an indigenous grass, which seems to have been greatly assissted by increase in moisture content

consequent upon contour trenching. *Cenchrus ciliaris* grows or has been extensively sown in the Salt Range, Hoshiarpur Siwaliks and south eastern Punjab. It obviously cannot stand competition with grasses like *Dichanthium annulatum* and *Bothriochloa pertusa* and *Heteropogon contortus*. *Cenchrus* is thus more suited as a pioneer crop where competition is absent or less keen. *Dichanthium annulatum* on the other hand seems to be in its optimum locality in Nurpur fields. Its plots have remained pure or almost pure, *viz.* field Nos. 2 (*i*), 3, 4 (*ii*), 5. Its only associates so far are *Heteropogon contortus* and *Apluda aristata*. The latter is restricted to the berms or newly made up earth near the trenches. It would be instructive to watch the competition between *Dichanthium annulatum* and *Heteropogon contortus*.

Cynodon dactylon field was bound to be invaded as *Cynodon* requires a special treatment for its maintenance as a dominant grass. *Heteropogon contortus* has made great inroads but there is no *Dichanthium* so far.

Heteropogon contortus is vigorous in its field. Its only associate is *Apluda* but so far its area is restricted. It is believed that *Apluda* was introduced when *Heteropogon* was sown as the *Heteropogon* seed was found mixed with *Apluda* seed.

With *Sorghum halepense* it was hoped to cover the entire field but it only succeeded in select places. The rest of the area has been colonised by *Bothriochloa pertusa* and *Apluda aristata*.

Apluda aristata has maintained its dominance though on account of its special partiality for fresh soil and moisture it cannot form a pure crop over the entire field. Its associates are *Bothriochloa pertusa* and *Heteropogon contortus*.

Chrysopogon montanus is a very common grass of the Kangra Division but in spite of its having been sown and tended it has not been able to maintain its dominance and has been replaced by *Bothriochloa pertusa*.

Themeda anthera has almost entirely disappeared.

The succession so far in Nurpur fields has tended to show that *Themeda anathera, Cenchrus ciliaris* and *Chrysopogon montanus* are lower in the scale of succession (*i.e.* are pioneer species) than *Dichanthium annulatum, Heteropogon contortus* and *Bothriochloa pertusa*.

SUMMARY OF REVENUE AND EXPENDITURE AND SURPLUS OF THE FOREST

Heads	Imperial	Bengal	United Provinces	Punjab	Bihar	Orissa	Assam	Central Provinces and Berar
Revenue—								
Timber and Other Products—								
Average of three years ending 31st March, 1939 ..	..	20,77,098	50,58,376	23,03,134	6,79,662	4,98,067	17,01,719	48,93,982
1939-40 ..	..	23,98,085	56,57,595	25,39,565	8,36,148	6,53,016	17,45,412	50,43,788
1940-41 ..	..	25,97,830	72,40,050	35,69,919	9,63,712	8,02,038	24,37,562	61,58,275
Expenditure—								
Conservancy, Maintenance and Regeneration—								
Average of three years ending 31st March, 1939 ..	..	6,03,157	10,80,822	13,23,463	1,51,845	1,66,850	3,17,168	14,51,990
1939-40 ..	..	6,79,974	11,68,016	12,47,162	1,73,384	2,99,804	3,67,023	15,05,465
1940-41 ..	..	7,17,656	12,13,416	13,73,963	1,77,477	3,30,915	4,05,715	18,79,771
Establishment—								
Average of three years ending 31st March, 1939 ..	53,564	9,51,914	18,77,869	11,08,289	4,01,021	3,37,749	8,58,114	20,37,032
1939-40 ..	40,145	10,60,078	18,82,755	12,60,818	4,26,460	3,43,671	7,93,935	20,31,116
1940-41 ..	53,976	10,46,337	17,79,409	12,22,176	4,13,437	3,50,335	8,43,797	20,17,525
Total of Expenditure—								
Average of three years ending 31st March, 1939 ..	53,564	15,55,071	29,58,691	24,31,879	5,52,666	5,04,599	11,75,283	34,89,003
1939-40 ..	40,145	17,40,052	30,50,771	25,07,980	5,99,844	6,43,475	11,60,958	35,36,581
1940-41 ..	53,976	17,63,993	29,92,825	25,96,139	5,90,914	6,81,250	12,49,512	38,97,296
Surplus (+) *or Deficit*(—)								
Average of three years ending 31st March, 1939 ..	—53,564	+5,22,026	+20,99,676	—95,411	+1,26,997	—6,533	+5,26,537	+14,04,980
1939-40 ..	—40,145	+6,58,033	+26,21,559	+31,585	+2,36,304	+9,541	+5,84,454	+15,07,207
1940-41 ..	—53,976	+8,33,837	+42,47,225	+9,73,780	+3,72,798	+1,20,788	+11,88,050	+22,60,979

DEPARTMENT IN INDIA, FOR THE FINANCIAL YEARS 1939-40 and 1940-41

Coorg	North-West Frontier Province	Ajmer-Merwara	Baluchistan	Andamans	F. R. I. and College	Madras	Bombay	Sind
3,55,929	5,15,526	74,608	1,10,505	14,03,679	98,576	46,26,676	43,82,310	8,07,601
3,26,566	5,22,025	43,488	1,60,558	12,79,818	1,59,936	42,91,828	38,60,605	7,76,348
4,04,260	9,10,904	49,238	1,39,354	19,55,587	1,66,906	46,34,567	44,53,768	7,31,248
85,767	1,46,264	25,938	..	9,06,946	74,049	..	..	..
79,162	1,59,749	16,597	1,09,147	10,05,990	76,735	13,93,915	6,81,913	52,637
1,02,920	3,16,530	16,597	81,917	11,50,307	1,04,006	13,18,320	8,31,186	58,574
1,13,875	2,13,272	33,181		1,72,352	5,85,384	..	..	..
92,102	1,92,582	25,914	37,849	1,68,320	6,17,147	24,62,586	19,47,953	3,13,143
92,756	1,83,220	27,102	39,405	1,74,786	6,41,701	24,17,583	19,77,568	3,15,013
1,99,668	3,59,536	59,452	89,889	10,79,298	6,59,427	40,47,759	27,40,219	3,46,166
1,71,264	3,52,331	42,511	1,46,996	11,71,310	6,93,882	38,56,501	26,29,866	3,65,780
1,95,685	4,99,750	43,699	1,21,322	13,25,093	7,45,707	37,35,903	28,08,754	3,73,587
+1,56,261	+1,55,990	+15,490	+20,616	+3,33,378	−5,60,850	+5,72,250	+16,42,090	+4,61,436
+1,55,302	+1,69,694	+977	+13,562	+1,05,508	−5,33,946	+4,35,327	+12,30,739	+4,10,568
+2,08,575	+4,11,154	+5,539*	+18,032	+6,30,494	+5,78,801	+8,98,664	+16,45,014	+3,57,661

*The great famine of 1939-40 ended in August 1940. The villagers have not yet completely recovered from the famine effects.

FLOWERING AND FRUITING OF FOREST TREES OF CEYLON—II

BY C. H. HOLMES

In the case of the dry zone species or species fruiting in the dry zone at times apparently more appropriate to localities of the wet and intermediate zones, the problem is a little more difficult. There is, however, a period of local pre-monsoonal thunderstorms before the south-west monsoon sets in. These rains occur generally about March, April and May, are widespread throughout the island and occur also in the dry zone where the north-east monsoon alone is responsible for the principal rains. The monthly average rainfall statistics given by the Colombo Observatory illustrate this fact amply as will be seen from the figures for the 10 dry zone stations given below:

MONTHLY AVERAGE RAINFALL—DRY ZONE

Station	Jan.	Feb.	Mar.	Apr.	May.	June
1. Anuradhapura ..	5·64	1·65	3 93	5·30	3·16	0·25
2. Batticaloa ..	13·78	2·66	3·35	1·78	1·90	1·06
3. Buttala ..	5·91	2·56	6·63	8·30	3·56	0·73
4. Dambulla ..	10·48	2·35	5·08	6·63	3·03	1 69
5. Hambantota ..	3·71	1·08	3·83	3·28	3·43	2·25
6. Iranaimadu ..	6·78	2·04	2·00	2·83	2·22	0·80
7. Jaffna ..	4·38	1·20	1·80	1·50	1·68	0·41
8. Puttalam ..	3·57	1·03	3·36	4·84	3·71	1·63
9. Trincomalie ..	8·68	2·02	2·40	1·98	3·43	1·04
10. Vavuniya ..	6·66	1·67	2·83	4·54	3·55	1·10

Station	July	Aug.	Sept.	Oct.	Nov.	Dec.
1. Anuradhapura ..	1·46	1·57	4·25	2·60	11·25	8·17
2. Batticaloa ..	1·14	1·77	2·60	7·06	15·92	17·17
3. Buttala ..	1·90	2·16	3·35	9·76	12·68	8·16
4. Dambulla ..	1·67	1·57	3·55	2·42	12·27	10·56
5. Hambantota ..	2·46	1·01	3·10	4·87	7·82	5·59
6. Iranaimadu ..	0·80	1·12	2·89	9·80	17·24	13·98
7. Jaffna ..	0·60	1·08	3 01	9·54	16·35	9·40
8. Puttalam ..	1·34	0·28	1·78	8·05	10·00	6·23
9. Trincomalie ..	1·90	3·53	3·77	9·18	14·29	15·59
10. Vavuniya ..	1·30	2·04	4·19	8·84	13·43	12·15

It will be noted that several of the species of this type are hardy and shew marked resistance to drought, *e.g. ehela,* dikwenna, vel-vel* and *wira*. Particularly under shelter from the parent overwood seedlings in such cases probably take advantage of the rains in these months and successfully tide over the remaining months of comparative drought to recommence growth from the very commencement of the north-east rains. In the case of species with seeds requiring either predigestion, weathering or maturing after fall, *e.g. ehela* and *lunmidella* it is reasonable to suppose that fruiting sometime prior to the principal rains would be advantageous or even essential. Unfortunately, not sufficient is known about all species concerned to develop this possible explanation of irregular and seemingly disadvantageous out-of-season fruiting.

Similarly, no special disadvantage need be suffered on account of out-of-season fruiting by species whose seeds retain their germination capacity unimpaired or only slightly affected and remain viable until the next rains, *e.g. lunmidella, ehela, tamarind, vel-vel, halmilla* and *wa*. On the contrary, that the seed by then should have reached the ground and probably have been dug into the soil through one or other animal agency ready to germinate with the commencement of the rains, cannot but be considered of definite advantage.

The chances are that the explanation of the phenomenon of irregular flowering and fruiting by which is meant the explanation of its success despite apparent anomalousness, is not to be found in any one circumstance or factor. Nor is it to be expected that the same factors or reasons, whatever they are, apply in all cases. Undoubtedly a large number of different factors within and outside the plants, some of which apply in certain cases and others in other cases, determine why it is that the time of flowering and fruiting may vary independently of weather conditions without affecting adversely the propagation of the species concerned. There is no real necessity to seek to find parallelism between climatic seasons and periods of flowering and fruiting in the tropics, nor to assume that times of flowering and fruiting have at one stage or another in the earlier history of a species been determined by climatic conditions alone.

**ehela* (*Cassia fistula*, L.); *dikwenna* (*Pityranthe veraucosa*, Thw.); *vel-vel* (*Acacia leucophloea*, Willd.): *wira* (*Hemicyclia sepiaria*, W. & A): *lunmidella* (*Melia composita*, Willd.); *halmilla* (*Berrya cordifolia*, Burret.); *wa* (*Cassia siamea*, Lam.).

It will be appreciated that the information gathered is on mass flowering and fruiting as distinct from flowering and fruiting of individual trees. Observations on individual trees in "Phenological" plots, which are now in the process of being selected, should in time bring out important features which must inevitably be masked when trees "en masse" are considered. Widespread flowering and fruiting over an extended period of time each year may only be the next result of independent annual or cyclic functions amongst the individual trees observed and recorded. Similarly the annual flowering and fruiting of certain species recorded here may conceivably be the result of cyclic flowering and fruiting in different groups of trees observed each year. It is not sometimes clear from casual observations on different trees whether fruits observed in any one year are those of the flowering of that year or the year previous. All these points one might expect to clarify from observations to be made on individual trees in the work that is being taken up now.

In the meantime, it will also be recognized that knowledge of mass flowering and fruiting could actually be of greater practical value than some of the details that would be discernible only from observations on individual trees. The value of the information gathered so far, were it merely to tell us where and when seeds of the species dealt with are to be found, would be obvious. Knowledge of the periods of flowering and fruiting will also help in timing silvicultural regeneration operations. It will indicate at least roughly when such operations are likely to favour the natural regeneration of certain species. Contrariwise, what particular species as opposed to others fruiting at other times, excepting of course species the seeds of which retain their viability over long periods of time and remain dormant awaiting favourable conditions for germination, are most likely to give immediate response to regeneration fellings when other circumstances decide time of felling.

Brief notes on information gathered in respect of each of the species studied are given below. Against the caption "Distribution" are given the forest ranges from which information has been obtained and these do not always cover the whole geographical range of a species. A tabulated statement is appended summarising the information on all species, indicating the major climatic zones in which

each species is found and the principal months of flowering and fruiting, for easy reference.

Not all field officers have contributed equally to the collection of this information and there are some whose interest had apparently not been roused or for other reasons have not been able to make any appreciable contribution. The majority, however, from Foresters down to Overseers have helped much. Though it is not possible to name them, all sincere thanks are due to each and all of them in acknowledgment of their interest and collaboration.

A. *Dilleniaceae*:

1. *Dillenia retusa, Thumb.* Sinhalese: *godapara*
Tamil: *pasu punalai.*

Distribution: Galle, Matara, Ratnapura, Avissawella, Waga, Matugama, Elpitiya, Ingiriya, Kegalle, Kurunegala and Mirigama Ranges.

Flowering has been observed throughout the year but principally at the beginning and towards the end of each year. As is to be expected, fruiting is similarly not restricted to any definite period though as in the case of flowering, ripe fruit appears to be available more generally at about the beginning and close of each year. Trimen records the months of flowering as being July and August. Actual seed collections have been made in December and January to March.

2. *Wormia triquetra, Roxb. Sinhalese*: *diyapara.*
Distribution: Galle, Matara, Avissawella, Waga, Matugama, Ingiriya, Kurnegala Ranges.

As in the case of *godapara* this species is found flowering and fruiting practically all the year round. Trimen, however, records flowering in December-January. From reports collected during the four years of observation it would appear that both flowering and fruiting are more frequent and general during September to December/January than at other times. Owing to the showy large white flowers, reports on flowering have been much more numerous than on fruiting.

B. *Dipterocarpaceae*:

3. *Dipterocarpus zeylanicus Thw.* Sinhalese: *hora.*
Distribution: Galle, Matara, Matugama, Ingiriya, Ratnapura, Waga, Avissawella, Kegalle, Dandagamuwa, Mirigama Ranges.

Flowering is usually at its height in the months of November and December. It begins generally about October and lasts to February. Trimen mentions February as the month of flowering. The fruits ripen in March/April and continue to fall to May. Fruits have been observed much later in the Galle and Matara districts but whether this is constant requires to be established by further observation. There is a suspicion that though this species flowers and fruits annually it exhibits a periodic cycle of bumper seed years. There is, however no definite recorded evidence in support of this and it is probable that a good speed year is merely fortuitous resulting from favourable weather conditions and perhaps reduced incidence of insect or bird damage on the young fruit. "Seed" collections for use in our nurseries and experimental gardens have been made mostly in March and April.

4. *Vateria copallifera.* Ritz. Sinhalese: *hal.*
Distribution: Avissawella, Waga, Ratnapura, Matugama, Ingiriya, Kegalle, and Galle Ranges.

Flowering commences about January/February and continues to April/May. The period of maximum flowering is generally March/April. Trimen regards April/May as the months of flowering. Mature fruits are available September to November and "seed" fall has been observed principally in the month of November. "Seed" collections for experimental purposes have been made mostly in the months of September to November.

C. *Malbaceae*:

5. *Gossampinus malabarica, D.C.* Sinhalese: *katu-imbul.*
Tamil: *parutti.*
Distribution: Ratnapura, Elpitiya, Matugama, Galle, Matara, Kurunegala, Kandy, Kekirawa Ranges.

The period of flowering is generally from December to February coinciding with leaf fall. Leaf fall cannot, however, be regarded

as a sexual function associated with flowering as young plants of but one to three years of age in our experimental gardens are found to be deciduous at the same time as mature trees. Trimen and Herbert Wright both give January/February as the months of flowering. The fruits develop quickly soon after flowering and ripen in March/April. According to Herbert Wright the fruits set in March/April and disburse their cotton and seeds in April when the trees reflush. Seeds collections for experimental purposes have been mostly in March and April.

D. *Tiliaceae*:

6. *Pityranthe veraucosa. Thw.* Sinhalese: *dikwenna.*
Tamil: *vidpannai.*

Distribution: Principally in the Trincomalie District—also recorded from the following Ranges: Kekirawa, Kurunegala (Likoluwewa, Kala-Oya) and Batticaloa.

Information on this species has been obtained chiefly from the Trincomalie Range (Forest Ranger, Mr. K. Velupillai). The period of flowering is mainly from October to January. Trimen records flowering as being from September to January. Ripe fruit appears to be available in the months of March-April.

7. *Berrya cordifolia, Burret.* Sinhalese: *halmilla.*
Tamil: *chavandolai.*
Trincomalie Wood.

Distribution: Trincomalie, Batticaloa, Kekirawa, Anuradhapura, Kurunegala, (Rathkarawa) Ratnapura, Haputale (Butala) Ranges.

Both flowering and fruiting have been observed sporadically in every month of the year. The recorded observations, however, appear to indicate two principal periods of flowering when it is both most frequent and more general than at other times of the year, *viz*: at the beginning, January/February, and again at the middle of the year, June/July. Trimen records flowering as in July-October. In the case of fruiting, the main general season when ripe dehiscing fruit is most commonly observed is August to October/November. Fresh matured seed has been collected, principally in September/October but also in June, July, August and December.

E. *Buseraceae:*

8. *Canarium zeylanicum, Bl.* Sinhalese *dik-kekuna.*
kekuna.
Tamil: *pakkilipal.*

Distribution: Galle, Matara, Elpitiya, Matugama, Avissawella, Waga, Kurunegala, Kegalle, Dandagamuwa-Chilaw Ranges.

The number of recorded observations collected on flowering have been comparatively few perhaps on account of the flowers being inconspicuous particularly on such lofty trees as they are of this species. They indicate February and March as the months of flowering and this confirms Trimen who also records the same months. A large amount of information has, however, been collected on fruiting which has been observed all throughout the year. Ripe, immature fruits and flowers have sometimes been observed at the same time on different trees in the same locality. There is evidence of ripe fruit being available in June/July in the Kurunegala, Kalutara and Galle districts but summarised for the whole island, the statistics collected sum to indicate January-February and September-October and November as being the periods when ripe fruits are most generally and frequently observed. Seed collections have been made principally in June-July and December to February.

F. *Meliaceae.*

9. *Melia composita, Willd.* Sinhalese: *lunumidella.*
Tamil: *malai-vempu.*

Distribution: Galle, Matara, Elpitiya, Ratnapura Avissawella, Waga, Kegalle, Kurunegala, Dandagamuwa, Puttalam (Chilaw), Badulla, Batticaloa (Maha-Oya), Haputale (Moneragala) Ranges.

Comparatively few reports have been received on flowering but these indicate fairly definite that months of flowering are generally March-April. Trimen records February. Flowers appear only when leaf fall is completed and reflushing of the leaves commences at the close of flowering. A large number of observations have been recorded on fruiting. These shew that ripe fruit is available practically all throughout the year, but particularly in the period Decem-

ber to February/March. Several observers, e.g. at Kurunegala, Dandaganiuwa, Chilaw, Badulla, Matale and Maha Oya, have recorded "ripe fruit-falling" in May, June and July. The fruit takes nearly a year to mature.

10. *Azadirachta indica, A. Juss.* Sinhalese: *kohomba.*
Tamil: *vempu*
Margosa.

Distribution: Batticaloa, Trincomalie, Jaflna, Anuradhapura, Kekirawa, Puttalam, Kurunegala (North) Ranges.

The information collected indicates very strongly that the period of flowering in generally April-May-June. Trimen notes flowering as from March to May. The period of fruiting is equally definitely: August-September-October—ripe fruit being available particularly in the last two months. Fresh seed for experimental purposes has been collected mostly in September and October.

11. *Walsura piscidia, Roxb.* Sinhalese: *kirikon.*
Tamil: *chaddavakku.*

Distribution: Trincomalie, Batticaloa, Jaflna, Anuradhapura, Vavuniya, Kekirawa, Puttalam, Haputale (Wellawaya) Ranges.

Flowering has been observed from January to April. February-March appear to be the months when it is most general and frequent. Trimen records March as the month of flowering. Fruiting has been observed in all months of the year excepting the first two. Ripe fruit appears generally to be available in June/July. It is possible that this fruit is set in the previous year and the immature fruit observed during the rest of the year is that of the current year of observation.

12. *Chloroxylon swietenia, D.C.* Sinhalese: *buruta.*
Tamil: *mutirai.*

Distribution: Trincomalie, Batticaloa, Vavuniya, Jaffna, Anuradhapura, Kekirawa, Puttalam, Ratnapura (Rathkarawa), Darawela, Embilipitiya—Pallebedda), Kurunegala (Gokanella-Maho), Haputale (Telulla, Kumbukkan, Darragoda, Bibilihela) Ranges.

The height of the flowering season appears to be about April/May, but flowering has been observed as early as in March to as late as in July. Trimen mentions flowering as from April to June. Flowers appear when the trees are almost leafless. According to Herbert Wright new flush of leaves are produced in May. Fruits ripen and dehisce about July/August and seed is generally available up to September/October. Seed collections for experimental purposes have been made from July to October, mostly in July and August.

G. *Sapindaceae.*

13. *Schliecera oleosa, Merr.* Sinhalese: *kon.*
Tamil, *puva kula.*

Distribution: Batticaloa, Trincomalie, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Kurunegala, Haputale (Wellawaya), Elpitiya Ranges.

Flowering is very definitely about March/April throughout its range of distribution. Trimen gives March as the month of flowering. Ripe fruit is most generally available in June/July, though seed fall may begin in May and continue to August/September. Seed collections have been made in May, June, July, mostly in June and July.

H. *Anacardiaceae.*

14. *Mangifera zeylanica, Hk.f.* Sinhalese: *etamba,*
Sometimes, *wal-amba.*
Tamil: *kaddu-manga.*
wild mango.

Distribution: Galle, Matara, Elpitiya, Matugama, Ratnapura, 'Waga, Avissawella, Dandagamuwa, Trincomalie and Batticaloa Ranges.

Flowering is generally most frequently observed in the months January, February and March, though it may quite commonly be observed as late in the year as November. Trimen records the months of flowering as being February-March. There is some indication from the reports received from Trincomalie that the flowering takes place there somewhat later in April, May, June, but this requires to be confirmed by further observations. Ripe fruit becomes available in May, June, July and here again there is a suspi-

cion that it is little later and persisting up to September in the Trincomalie district. Seed collections have been made in April, May, June—chiefly in May.

I. *Leguminaceae.*

a. *Caesalpinieae.*

15. *Cassia fistula*, L. Sinhalese: *ehela.*
Tamil: *tiru-kondal, konnei.*
Indian laburnam.

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Puttalam, Kurunegala, Haputale (Wellawaya) and Elipitiya Ranges.

Flowering reaches its height generally about June/July but extends from May to October or even November/December. Trimen gives July/August as the months of flowering. Ripe pods from the previous year's flowering are available synchronously with flowers generally in May, June, July. The old pods remain long on the trees sometimes together with the fresh green pods of the subsequent year. Seed collections made have been chiefly in May and *June.*

16. *Cassia marginata*, Roxb. Sinhalese: *ratu-wa.*
Tamil: *vakai.*

Distribution: Trincomalie, Batticaloa, Kekirawa, Ranges. (Common in the Dry Zone, but reports have been received only from these ranges).

A very large number of observations have been consistently recorded by the Range Forest Officer, Trincomalie (Mr. K. Velupillai) during the years 1937 to 1940 inclusively. These observations have been supplemented and continued by those of the Range Forest Officer, Batticaloa (Mr. P. E. E. Anthonipillai). Comparatively few reports have been received from other ranges. August to November appear to be the principal period of flowering though observed also in June/July or earlier. Trimen records July and August as the months of flowering. The pods ripen mostly in May and June from flowers of the previous year.

17. *Cassia siamea, Lam.* Sinhalese: *aramana.*
wa.
Tamil: *vakai.*

Distribution: Anuradhapura, Batticaloa, Kurunegala, Kegalle, Haputale (Moneragala), Dandagamuwa Ranges.

Flowering has been observed practically all the year round, but particularly towards the end of the year—August to November. Trimen records flowering in March and November. Similarly fruiting has been observed at all times, more generally about the middle and end of the year. Seed has been selected from ripe pods mostly in May, June, July but also in December.

18. *Tamarindus indicus, L.* Sinhalese: *siyambala.*
Tamil: *puli.*
tamarind.

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Kekirawa, Kurunegala, Ratnapura (Pallebedda) Puttalam Ranges.

This is an introduced species. It is not found naturally in dry zone forests though frequently found growing in this region either under cultivation or as scattered "Escapes" from cultivation on the fringes of forests bordering on village lands.

The flowering season is generally July-August-September—the height of the season being about August. Young pods are observed soon afterwards but ripen only about April and chiefly in May and June of the following year. Seed collections for experimental purposes have been made in April and June.

b. *Mimoseae.*

19. *Acacia leucophloea, Willd.* Sinhalese: *maha* or *katu-andara, kerriya.*
Tamil: *velai-maram*
vel-vel.

Distribution: Trincomalie, Jaffna, Vavuniya, Anuradhapura, Kekirawa and Puttalam Ranges.

Trees when in bloom are extremely conspicuous and as is to be expected, numerous observations on flowering have been recorded in

all ranges. The flowering season is generally July, August, September, culminating about August. Trimen records flowering as in August. The information on fruiting is dependent mainly on the observations recorded in the Trincomalie district. These indicate strongly that ripe fruit is generally available in April/May and sometimes in March. Seed collections for experimental purposes have been made in May chiefly also in March.

J. *Combretaceae.*

20. *Terminalia arjuna, W. & A.* Sinhalese: *kumbuk.*
Tamil: *marutu.*

Distribution: Trincomalie, Batticaloa, Jaffna, Anuradhapuro, Kekirawa, Kurunegala, Ratnapura (Rathkarawa) Haputale (Moneragala & Badulla and Waga Ranges.

Widespread generally along streak and tank bunds of the dry zone but also though more rarely in the Intermediate and wet zones.

The flowering season is generally April/May extending frequently to June. Trimen records April and May as the months of flowering. The fruits set and become apparent very soon afterwards, from June/July onwards. They ripen about September/October and continue falling in November. Seed collections have been made in September.

(*To be continued.*)

TIMBER PRICE LIST, JULY-AUGUST, 1942

(INDIAN STATES)

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Cochin ..	Logs ..	Re. 0-9-3 per c.ft.
,,	,,	Travancore ..	Logs ..	
Benteak ..	*Lagerstrœmia lanceolata*	Cochin ..	Logs ..	Re. 0-8-0 to 1-3-8 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	Rs. 2-5-0 to per c.ft.
,,	,,	Travancore ..	Logs ..	Rs. 1-8-10 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Barwani ..	Logs ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Cochin ..	Logs ..	Re. 0-14-9 to 0-15-6 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Holkar ..	Beams 14′×18″	Rs. 2-0-0 per c.ft.
,, ..	,, ..	Hyderabad ..	Logs ..	Re. 0-10-0 to 1-8-0 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	Rs. 2-1-6 to 3-7-6 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-14-4 per c.ft.
Deodar ..	*Cedrus deodara* ..	Patiala ..	Sleepers 10′×10″×5″	Rs. 9-8-0 each.
Dhupa ..	*Vateria indica* ..	Cochin ..	Logs ..	Re. 0-12-11 to 2-0-0 per c.ft.
Gamari ..	*Gmelina arborea* ..	Tripura ..	Logs ..	Rs. 1-4-0 to 2-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Cochin ..	Logs ..	Re. 0-14-9 to 1-9-11 per c.ft.
,, ..	,, ..	Tripura ..	Logs ..	Rs. 1-0-0 to 2-0-0 per c.ft.
Haldu ..	*Adina cordifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Banswara ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	Re. 0-8-0 per c.ft.
,, ..	,, ..	Bhopal ..	Logs ..	
,, ..	,, ..	Cochin ..	Logs ..	
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	Rs. 1-7-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-8-11 per c.ft.
Hopea ..	*Hopea parviflora* ..	Cochin ..	Logs ..	Rs. 1-8-7 per c.ft.
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-9-11 per c.ft.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	Re. 1-0-0 per c.ft.
,, ..	,, ..	Cochin ..	Logs ..	Rs. 1-1-3 to 4-8-7 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Kishengarh	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	Rs. 2-5-6 to 4-0-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-8-0 to 1-15-3 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul ..	*Xylia xylocarpa* ..	Cochin ..	Logs .	Re. 0-8-11 to 1-8-7 per c.ft.
" ..	" ..	Travancore..	Logs ..	Rs. 1-7-10 per c.ft.
Kindal ..	*Terminalia paniculata* ..	Cochin ..	Logs ..	Re. 0-8-7 to 1-6-2 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 1-13-0 per c.ft.
" ..	" ..	Travancore..	Logs ..	Rs. 1-11-0 per c.ft.
Laurel ..	*Terminalia tomentosa* ..	Bansda ..	Logs & squares	
" ..	" ..	Barwani ..	Logs ..	Re. 0-10-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Re. 0-14-0 to 1-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	
" ..	" ..	Holkar ..	Sawn material	Rs. 3-0-0 per c.ft.
" ..	" ..	Hyderabad..	Logs ..	Re. 0-6-0 to 1-8-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 1-11-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore..	Logs ..	Rs. 1-13-4 per c.ft.
Mesua ..	*Mesua ferrea* ..	Cochin ..	.	
" ..	" ..	Tripura ..	Logs ..	
Sal ..	*Shorea robusta* ..	Cooch Behar	Logs & scantlings	Rs. 1-0-0 & 2-2-0 to 2-8-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Tripura ..	Logs ..	Re. 1-8-0 to 2-4-0 per c.ft.
Sandan ..	*Ougeinia dalbergioides* ..	Bansda ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Banswara ..	.	
" ..	" ..	Cochin ..	Logs ..	Re. 0-9-3 per c.ft.
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-6-0 to 0-8-0 & 0-12-0 per c ft.
"	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
" ..	" ..	Travancore..	Logs ..	
" ..	" ..	Tripura ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
Sissoo ..	*Dalbergia sissoo* ..	Banswara ..	..	
" ..	" ..	Cooch Behar	Logs & scantlings	Re. 0-12-0 & 1-12-0 to 2-8-0 per c.ft.
" ..	" ..	Hyderabad..	Logs ..	Rs. 1-8-0 per c.ft.
" ..	" ..	Rampur ..	Planks 6′×1′×1¼″ ..	
Teak ..	*Tectona grandis* ..	Bansda ..	Logs ..	
" ..	" ..	Banswara ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	Re. 0-12-0 to 1-8-0 per c.ft.
" ..	" ..	Bhopal ..	Logs ..	Rs. 1-8-0 to 2-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 1-0-7 to 3-7-5 per c.ft.
" ..	" ..	Holkar ..	Sawn material	Rs. 4-0-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 3-0-0 to 3-14-0 per c ft. Poor quality.
" ..	" ..	Travancore..	Logs ..	Re. 0-14-9 to 1-7-6 per c.ft. Rejected.

MORE EXAMINATION QUEERIES

45. A demonstration fuel plantation gets reduced to ashes by the village looney. Would you call this a biotic or an idiotic climax?

46. Would you call a proposal in writing a sort of tender notice and should the lady demand earnest money?

47. Explain the paucity of bark in dogwood.

48. How would you deal with an outbreak of *Exkewsis speciosus* in your division?

DRIVELLARIA

45. Kamrup cattle, they say, are being given salt with their thatch grass.

    Sowing mustard would presumably savour of cruelty to animals.

46. First Hoplocerambyx beetle: "Hello, said goodbye to your host?"

    Second ditto : "Yes, he seemed bored to death."

47. Someone at the last Silvicultural conference, it is rumoured, suggested handing over the problem of spike in sandal to *mochis*.

48. Mother Anopheles: "Quick children, the quinine. I've just come from one of those chronic malarial cases."

Honours for Forest Officers.—We regret that in the August 1942 issue of the *Indian Forester* the name of Mr. Jagat Singh, officiating Assistant Conservator of Forests, Bihar, who receives a "Rai Sahib" in the Honours Lists, extracts which were given in the said issue, has inadvertently been left out.

We offer congratulations to Rai Sahib Jagat Singh at the distinction conferred on him.

EXTRACTS

SUGGESTIONS FOR A PLAN, PART II*

BY SIR ALEXANDER RODGER,

Formerly Inspector-General of Forests to the Government of India

The writer has received a large number of letters from people who are interested in forestry, as woodland owners, land agents, professional foresters, or timber merchants, and has had his outlook considerably extended and improved by the criticisms offered because

* Part I reproduced in the *Indian Forester*, Vol. LXVIII, No. 1, dated January, 1942—*Ed.*

they are all people whose opinion on the subject is of value and they look at the matter from many different points of view.

It cannot be said that the problem has been made much easier of solution by the considerations of which stress has been laid in these letters, but one conclusion has been most definitely arrived at by everyone, and that is that the present arrangements under which private forestry is carried on in this country are unsatisfactory. Whatever the opinion of these experienced correspondents may be, they are unanimous in demanding far-reaching changes.

The writer's proposals have received much support and several correspondents have agreed with all of them. The principal criticism has been the constitution of the Governing Body, as some people think there is no need to have a new administrative machine when one already exists. This is very reasonable and the majority of foresters will probably agree with the proposed formation of a "Forest Authority" as described in the final draft of the Society's memorandum on post-war Policy, recently circulated.

It is proposed that private owners shall be represented on this Forest Authority, and it is essential that this representation shall be real and that the representatives shall be men who are good technical foresters.

Discussing "Supervision of Private Woodlands," the memorandum says:

"The Plan should be so designed that while it prevents abuses in badly managed woodlands, it allows freedom of enterprise in those which are well managed."

The details as regards registration of "Approved Estates," returns of woodland ownership, and so on, under this head do not appear to be inconsistent in principle with the proposals put forward by the writer, and the same may be said of the measures proposed under paragraphs III, Marketing of Produce, IV Education, and V Pests.

The writer suggests that the memorandum would have more force if it had been better drafted, and if more details of the proposals had been given.

The letters received contain much support for the writer's contention that the private owners must work out their own salvation

because they can do it better than any Government department, but one experienced woodland owner says: "Granted, on two conditions, (1) if they have the funds and (2) if they have the knowledge." Sir James Calder, too, on page 162 of the October number of the *Quarterly Journal of Forestry*, says: "I am satisfied that the management of woods on private estates can be much better managed by the owners when they take sufficient interest in them to look after them than by any body of officials."

Note.—The owners must take an interest in their woods.

Mr. J. C. Brown thinks that most people who have to manage private estates would be in favour of less control, and not more, after the war.

An objection to State control raised by Mr. R. Thompson would be done away with under the writer's scheme, as the experts employed would be thoroughly conversant with local conditions. The editor in the same number of the Journal points out that "working plans" have a bad name on many estates, because they have frequently been drawn up by State foresters who have had little experience of the management of private woodlands. But a working plan may be "a flexible and easily revised scheme of management." The writer strongly deprecates the avoidance of the use of this term in private forestry because it is a well-established expression which embodies technical efficiency in all the countries where forestry has attained a high level. It is to be hoped that British forestry may at some future date rise to that level, though at present it shows few signs of doing so.

The writer believes that there can be no good forestry without good working plans, and bases this opinion on extensive experience, not only in Great Britain, but in India and Bruma, and in Germany, Belgium, France, Switzerland, Austria, Bohemia and Finland. The paramount importance of good working plans, based on enumeration and careful examination of the growing stock, has never been appreciated in this country.

Sir William Schlich writes, in the third edition (revised) of volume III of his *Manual of Forestry*:

"It rests with the owner of the forest, in so far as his choice is not limited by the laws of the country, to determine in each case what the objects of management shall be, and it then becomes the

duty of the forester to see that these objects are realized to the fullest extent and in the most economic manner."

The objects cannot be realized without a working plan. The demand from expert foresters for technical efficiency is no new thing.

In 1903 a blue book was published with the title: "Minutes of Evidence taken before the Departmental Committee appointed by the Board of Agriculture to inquire into and report upon British Forestry."

Colonel Bailey, R.E., Lecturer in Forestry at Edinburgh University, and member of the committee, said in evidence:

"We urgently require two or three model forests of limited area to be owned and managed by the State."

(We have not yet got them!)

Dr. Schlich (as he was then), Principal Professor of Forestry at Cooper's Hill and member of the committee, said in his evidence:

"I think if the State could have a sort of inspector or expert attached, say, to the Agricultural Department or to the Commissioners of Woods and Forests, a man who was always available to give advice from time to time, or to go and inspect woods when advances had to be made, it would be very highly advisable."

Another of the great experts of those days, Sir William Somerville, Assistant Secretary to the Board of Agriculture, and member of the committee, said:

"I quite agree with the witnesses who say that the education of the landlord is the most pressing requirement before very great improvement can be effected. Until landlords can be convinced that forestry can do a great deal more than they believe at present can be done to develop the estate financially, I do not think we shall have a very great extension of sylviculture."

This Committee sat in 1902 and foresters will reflect on the "progress" that has been made in scientific forestry during the last forty years. In forty years many of our woods could have been vastly improved. It is difficult to understand why the appreciation of good forestry has been so extremely slow to develop in this

country, as there have been on the continent of Europe, within a few hours' journey even before the day of air travel, perfect examples of how forests should be managed and, within the Empire, the Indian Forest Service has proved itself during nearly a hundred years.

There are certainly some private woodland owners who have considerable knowledge of forestry and manage their woods well, but still there are not nearly enough of them and the general level of technical knowledge is very low. It is possibly necessary to go back to the gamekeeper to find the origin of this neglect, or rather deliberate avoidance, of good forestry on private estates and in this opinion I am supported by Mr. H. T. H. Foley in the *Quarterly Journal* for October 1941.

And it must never be forgotten that the plentiful supply of foerign timber which poured into this country in peace time has led landowners to believe that we need not, and indeed could not, produce any more than a small portion of the quantities required at a remunerative price. As evidence of the ability of the private owner to manage his own estates reference may be made to the discussion at Cheltenham in July 1937 on "The Management of Woodlands on Small Estates." Mr. L. S. Wood, who was at the time President of the Land Agents' Society, expressed the opinion that a small estate owner who really makes up his mind that he is going to manage his woodlands is quite capable of making a success of it. Other speakers mentioned a small sawmill as an essential part of every estate and doubtless the Deputy President of the Society will agree with that. Others who took part in the discussion, laid emphasis on treating the forester as an important person, and trusting him, and taking care that he was allowed to do his own work and was not treated as an odd-job man.

Dr. Mark Anderson made a plea for the small owner to try and grow more hardwoods, as they would on the whole suit a small estate better than conifers, and he also mentioned the difficulty of getting sound silvicultural advice.

The writer would like at this point to refer to his proposal that trained foresters should be put in charge of groups of small estates. It is not pretended that this proposition is original but it is desired

to lay great emphasis on it because the writer believes that small woodland estates, properly managed, can be of the greatest value to the country. He finds that two authorities at least have mentioned the subject. At the Cheltenham conference, Professor Troup advocated the amalgamation of numbers of small estates within an economic radius of the markets and the compilation of a combined working plan. Professor Stebbing, in "The Forestry Question in Great Britain," published in 1928, wrote: "In the meantime, it may be suggested, that if a group of proprietors, owning between them a fair area of woods and lands capable of afforestation, were to combine and appoint a fully trained and experienced forest officer to take charge; if in addition, the State assisted the landowners towards regenerating cut-over areas and afforestation—the cost per individual proprietor would not be excessive."

Professor Stebbing in the same volume describes the supervision by a State forest officer of some two hundred woods in a district in France, the ownership of the woods being separate, and some of them not covering more than thirty acres.

Mr. Kissin's article in the QUARTERLY JOURNAL OF FORESTRY for January 1941, contains a number of valuable hints for us as to how they manage small areas of forests in Denmark.

In that small country there were, in 1939, seven Co-operative Societies with a membership of 1,800, the members owning between them about 47,000 acres of woodland, that is, an average of about 26 acres each. Very few members of the Societies own more than 125 acres, and the greater part of these woods under co-operative management belong to owner-occupiers of farms. (A most experienced land agent recently, in a letter to the writer, expressed the opinion that estates which have a good balance and combination between agriculture and forestry are those likely to come through the present difficult times. They give more employment than purely agricultural estates, and their financial position is nearly always better.) Of course, in Denmark State control of private forests has been in existence since 1805, so that the woods must be much better than ours on the whole.

For each 5,000 acres of these woodlands (in round figures) the Societies employ a forester trained at a University. They do not

depend on amateurs. It is interesting to note that these experts are usually in favour of high forest "with a tendency towards selection, a system which appears to be particularly well adapted to small forests."

This matter is worth considering in this connection because it seems to be an extremely sensible, economical, and interesting method of managing woodlands and should appeal to the British forester. A well-known Danish forest officer, L. A. Hauch, who died recently at the age of 93, has recorded his views on oak and beech in Denmark in two small books which are worth reading. Herr Hauch had his essays translated into English and they were published in Copenhagen in 1936 and 1937. Selection forest forms the ideal form of *Dauerwald* which may be called "continuous forest," or forest treated so that the soil is never exposed on any part of the area. The present writer visited, in 1913, the famous communal forests at Couvet, Neuchatel, Switzerland, with M. Biolley, who elaborated his selection system in these forests and had been working there for more than twenty years. He stated that in some of the best compartments the increment had doubled during that time. These forests made an extremely favourable impression. M. Biolley published an account of his method of working under the title "Le Jardinage Cultural" in the Swiss Forestry Journal in 1901.

Major Ackers, after his visit to Switzerland, gave an account of the Selection System in the JOURNAL for July 1939. He says that they were given figures to prove that higher yields of large good timber can be obtained by this system than by any other and he also thinks that the woods worked under the selection system must be much more suitable for pheasant cover than ordinary high forest, and could be made as good for sport as coppice with standards.

On the subject of nationalization a beginning may be made with a quotation from a letter addressed to the writer by an important landowner: "It is of prime importance that the principle of private ownership should first be confirmed, and owners of woodlands given some feeling of confidence which is so necessary, as you emphasise near the bottom of page 44." The same correspondent also thinks that owners must be prepared to accept closer supervision

by some authority appointed by Parliament to act on behalf of the nation. "Self-discipline combined with direction from this higher authority are necessary rather than dictatorship and loss of freedom which have to be avoided."

Mr. Hiley, in the excellent articles published in the "Field" last April, expresses the view that good organization, if applied to the improvement of private ownership would have better results than if the same efforts were devoted to setting up a system of State ownership.

The general opinion seems to be against nationalization, but there are exceptions, and one valued correspondent who knows a great deal about forestry thinks the small private estate with, say, fifty acres of woods, is doomed, killed by legislation protecting the vagaries of tenants, death duties, taxation and so on. He continues: "Agreeing that on national grounds forestry should be developed and that derelict land should be planted, derelict woods brought back to production, and satisfactory woods maintained in good condition, I think that the only course is for the State to take over all woods." But Finland does what is necessary in another way, as the following extract from a report by the writer who spent nearly a month in Finland in 1937 will show:

"The policy of the Government is to keep the private forests in as good a condition as those belonging to the State, Companies, Communes and the Church, so that they may play their full part in sustaining a regular maximum yield."

Strict rules are made to ensure that the private forests are properly treated and the supervision of the observance of the law is carried out by district and communal forestry boards.

The number of small owners is very large. In the district of the S.W. Finland Forestry Board there are 1,175,000 acres of forest owned by 14,000 private persons and companies. The average farm has more forest than agricultural land and the average area of forest on each farm is about 80 acres. A most elaborate organization exists for helping the owners of these small forests and also seeing that they keep them in good order. At the other end of the scale we find a large mill-owning company in possession of nearly a million and a half acres, and besides that they buy from small

owners to keep their mills going. Such firms employ, of course, a staff of fully trained forest officers. It is difficult to get away from the idea that agriculture and forestry should work together and that (quoting an experienced forester whose recent letters to the writer have been very helpful), "It is to the Ministry of Agriculture with their vast and sympathetic staff that we private estate foresters should turn, rather than have to deal with and take orders from the present Forestry Commission."

If the Ministry of Agriculture is to be of importance to us, the opinion of Sir A. Daniel Hall must be considered. In his recent book, "Reconstruction and the Land," Sir Daniel Hall holds that the State is the only agency that can carry out the measures necessary to adapt the land to the new conditions and he advocates that the State should buy all the agricultural land in the country. Such a policy would have a tremendous effect on forestry, whoever the woods belonged to.

The opinion of Mr. H. J. Massingham is, however, very different. Writing to *The Times Literary Supplement* of August 30 last, he says: "As I see it, the vital thing to-day is to keep the idea and the spirit of the human person, of the small unit, of the regional nucleus, of individual responsibility and of creative work alive against the high tide of mechanization, money-values and centralized despotism which promises to overwhelm the soul of man." That is splendid. Down with Dictators! We should certainly have despotism in forestry if all the woods belonged to the State.

Mr. Rolf Gardiner, writing on the subject of Small-Holdings to *The Times* of December 15, 1941, makes some opposite remarks:

"The imagination of agricultural reformers has, however, boggled at the idea of self-subsistence. But is this really such an impossible method? If isolated holdings are intended, very likely yes. But group the holdings around a co-operative central farm for which the small-holdings supply team labour for hoeing, harvesting, and other operations, or, better still, around the vigorously led private agricultural estate with its crying need for the seasonal work of skilled hands in woodlands, quarries, and rural industries, and the holdings might very well succeed. The Land Settlement Association abandoned its original conception of a central farm in consequence of the commercial structure of its holdings. But an agri-

cultural estate with diversified production and reinvigorated rural industries would provide the hub of organic land-settlement. The revival of rural industries in conjunction with such estates, and schools for husbandmen along analogous lines to those of the Scandinavian folk schools, are the precondition of such settlement. Small-holdings hitherto have fostered the higgler's mentality; in future they must develop the husbandman's. For the purposes of self-subsistence husbandry are threefold: food, money for maintenance and amenities, and country-mindedness. All three might be earned by family farmers settled in conjunction with diversified rural estates."

Many correspondents point out that the Forestry Commission has failed to carry out the provisions of the Forestry Act of 1919 so far as it deals with private woodlands, and there is confirmation of this in some remarks made by the Chairman of the Forestry Commission after Major Ackers had read his paper on "Private Estates and Forestry" at a meeting of the Royal Society of Arts on February 26, 1941. His words, as reported in the JOURNAL of the Society were:

"As to the apparent neglect of private forestry in the twenty years I have been associated with the Commission, I think it is only right to say that the general environment over that period was certainly not favourable to the improvement of private woodlands. Time and again this question came up, and we had representative conferences on the whole subject: yet we never succeeded in seeing our way through the problem."

Surely it was the business of the State to create the necessary environment? It almost seems as if there was justification for a criticism sent to the writer, that the Commission is getting too much of a Civil Service outlook. Nothing could be worse for good forestry. It has been said: "If the progress of a nation is dependent, as we are now beginning to realize, upon its general appreciation of Science, that appreciation must be of the highest and broadest character."

One last quotation—from a speech by King George V: "Does not experience warn us that the rule of thumb is dead, and the rule of science has taken its place; that to-day we cannot be satisfied with

the crude methods which were sufficient for our forefathers, and that those great industries which do not keep abreast of the advance of science must surely and rapidly decline?"

There are a great many quotations in this article because the writer felt that he had developed his "plan" fairly well in the first part, and in the second he wished to support it as much as he could by the opinions of people who were worth quoting. Reading the opinions over again, he is struck by one dominating fact, and that is that first-rate technical administration will be the cure for most of our ills.

It is a strange thing that although many of our landowners and foresters have visited the forests of the Continent and must have realized that a high standard of technical efficiency is necessary to manage them properly, they have still been content to entrust the administration of many of the woods in this country to amateurs and others who know very little about forestry.

It is obvious, too, that the education in forestry available has not been taken advantage of as it should have been, and in some of the training schools the staff has been at times quite out of proportion to the numbers of students. This could have been avoided and economy and efficiency greatly increased if one central forestry school could have been established—say at Coopers Hill when that College was closed in 1906. At that time no one foresaw that the whole Empire would require foresters. The writer had at one time great hopes that Oxford would develop into a first-class research and training centre but the experience of recent years has led him regretfully to realize that the attitude of the University authorities is unlikely to lead to this result.

With our fantastic island humour we have been content to jog along, watching obviously in efficient forestry in force over large and valuable parts of our beautiful and fertile island.

The time has now come to scrap all that and employ trained and experienced foresters everywhere and it is to be hoped that the State will change its ways and give the lead.

—*Quarterly Journal of Forestry*,
Vol. XXXVI, No. 1, dated January, 1942.

RIVER FORESTS OF SARAWAK

By H. L. Edlin

I must, of course, ask the indulgence of those *Sylva* readers whose good fortune it is to be stationed in Sarawak, when recounting my tourist-trip experiences on a week-end visit to that country, on a tiny coasting steamer that sailed back a thousand years in time in a thousand miles of travel east of Singapore. The steamship company were unwilling to contract for my maintenance; they explained that food and drink were obtainable "by arrangement with the ship's cook"—in practice one dined and wined with the ship's officers, and "arrangements with the cook" were simple and purely financial.

We left the lights of Singapore at dusk one evening, and throughout the next day steamed over the dark spaces of the South China Sea. Soon after dawn on the day following, the grey blurry outline of mangrove forests showed up on the eastern horizon, and thenceforward the ship was enveloped by the jungles for the whole of its 150 miles' journey up the Rejang river to Bitanang. Though seemingly a trackless wilderness, this mangrove area is rich in fuel-wood and valuable training materials, obtained by treating the bark at a modern factory; transport is solely by water. The people of the delta are Milanaus, a Malayan tribe who are strict Mohammadans, and who lived by piracy and plunder until the advent of the steam gun-boat made fishing and navigating more profitable occupations.

Above the mangroves and the salt water lie the sago palm groves. The raw sago, obtained from the pith of the tree after felling, is refined by a primitive process of straining and drying, the business being run—like most of those in Malayan land—by a Chinese *towkay*. Transport is again by water, as I realized to the full when the ship steamed off upstream, leaving me apparently stranded as a stranger in a very strange land. However, there proved to be one European resident in Bintanang, a Dutch priest who sustained himself in his solitude on the slender hope of converting some of the pupils of his boys' school. He proved most hospitable, and next morning I continued my way on a motor-boat bus service, which called at all the quays amongst the rubber-groves on the way to Sibu,

the largest town on the river. Sibu boasts one motor car, but it is rather a luxury, as there is only one mile of road. The whole town is built on piles and is very subject to floods.

Above Sibu lie the upstream forests, untouched except by the roving tribes of heather Dyaks, to fell sections in order to grow hill paddy on the fertile soil. The growth which succeeds their brief occupation is known as *belukar,* a worthless thicket of shrubs, which is only slowly replaced by more valuable species. There was no evidence of *taungya* (that pet topic of silvicultural lectures), but as the Dyaks only very reluctantly left off head-hunting a very few years ago, it may be a bit difficult to get new ideas to take on with them.

The limit of navigation is at Kapit, and at the time of my visit this outpost of empire was in the sole charge of one Chinese clerk, the solitary District Officer having gone off into the Kulu to visit his outlying *penghulus* or village headmen. The chief sights of interests to the tourist are the old wooden block-house, still garrisoned by Sikhs, and the public park. This latter is an annexe to the jail, gardening being the most suitable form of hard labour for the local convicts. Their guard was armed with nothing but a red umbrella, but his charges could only escape either upstream or down—so trackless are the jungles—and in either case the nearest *penghulu* would be only too pleased to have an afternoon's sport in rounding them up.

Other items of interest to the forester are the sawmills that deal with the few valuable timbers whose export proves profitable, and the vast trade in rotans, gathered in the jungle by Dyaks for use in making furniture and basket work. There is an oil-palm plantation on the river, and the Chinese are establishing orchards of citrus and other fruits. Taxation of forest produce exported is a valuable source of revenue, especially in the case of rubber. The mode of rubber restriction then in force was to limit tapping to certain months of the year; this had the advantage of simplicity and of fairness to all, but the irregularity of employment led to the scarcity of good tappers.

As my steamer had remained at Sibu, I had made the last stage of the trip in unconventional fashion on the deck of a Chinese owned shallow-draught steamer. Feeding was again by arrangement with

the cook, and I learned to handle the *mah mee* with a deft chopstick. The run down stream was rather good, as we sailed even after nightfall in order to catch the steamer with our cargo, despite shifting sand banks and reefs which our Malay steersman seemed—in the absence of all lights—to sense out of the darkness.

Such was my glimpse of Sarawak, a land where the forest is the country, whose future must be bound up with the future of its trees. All of its varied people are forest-dwellers, and no part of the world can give more attractive scope for the work of a forest administration. The importance of forestry to this independent British protectorate has been well recognized by its rulers in gifts to the Empire schemes for forest research.

—*Sylva*, No. 22, dated 1941-42.

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INDIAN FORESTER

OCTOBER, 1942

RHYNCHELYTRUM NEES AND *TRICHOLAENA* SCHRAD IN INDIA

BY DR. N. L. BOR

The two genera named above seem to be imperfectly known and their taxonomy little understood in this country. The object of this note is to give revised descriptions of the species found in India, to illustrate them by means of a plate and finally to give their correct names.

Rhynchelytrum Nees and *Tricholaena* Schrad are two genera belonging to the tribe *Paniceae* and the sub-tribe *Meliniastrae,* a sub-tribe in which the spikelets are characterised by the possession of a small to minute lower glume, and awned upper glume and lower lemma; the upper lemma is firmly membranous to crustaceous in texture.

Stapf and Hubbard* found that, when revising *Meliniastrae* for the Flora of Tropical Africa, the species segregated from *Tricholaena* as *Xyochlaena* by Stapf in Hooker's Icones Plantarum were actually congeneric with *T. micrantha* Schrad. (now *T. teneriffae* Parl.) the type species of *Tricholaena* Schrad. It was felt by the two authors that these species differed sufficiently from *Tricholaena rosea* and its allies to warrant the separation of the latter generically from *Tricholaena* and the reconstitution of the genus *Rhynchelytrum* Nees for their reception. The two genera are close to one another but can be easily separated by the following key:—

Upper glume markedly gibbous; lower glume separated from the upper by a space over .6 mm. long.	1. *Rhynchelytrum.*
Upper glume not gibbous, gently curved; lower glume close to the upper or absent altogether.	2. *Tricholaena.*

1. *Rhynchelytrum* Nees

Spikelets ovate—or elliptic oblong to oblong in outline, laterally compressed, usually unsymmetrical in profile and gaping,

* Flor. Trop. Afr. IX. 869-870.

falling entire from the discoid tip of capillary pedicels, which are the ultimate branchlets of a decompound, loose or contracted panicle; florets two, dissimilar, the lower male or neuter and the upper hermaphrodite. Glumes very dissimilar, distant from one another; lower an oblong-hyaline scale, rounded, truncate or emarginate at the top, densely bearded at the base, pilose or glabrescent upwards, usually nerveless but sometimes 1-nerved; upper glume as long as the spikelet, cymbiform: narrowly to broadly dimidiate-ovate in profile, frequently gibbous below the middle, tapering upwards in a firm two-lobed beak, awned from the sinus of the two-lobed beak, 5-nerved, villous, often the hairs arising from tubercles between the nerves, ciliate on the margins. Lower floret male or barren; lemma similar in shape, texture and indumentum to the upper glume but narrower and much less gibbous: palea linear, somewhat shorter than the lemma, minutely 2-lobed at the tip, 2-keeled, hyaline, densely ciliate on the keels. Upper floret smaller than the lower, hermaphrodite, somtimes deciduous before the rest of the spikelet; lemma thinly chartaceous in texture, ovate to elliptic or elliptic-oblong in shape, finely five-nerved, glabrous, smooth and shining, truncate or notched at the apex; palea of the same texture as the lemma, two-nerved, almost as long as the lemma, not keeled, but rounded. Lodicules two, very small. Stamens three. Styles distinct, stigmas plumose, laterally exserted. Caryopsis oblong-ellipsoid, closely embraced by the lemma and palea; scutellum half as long as the grain; hilum basal, punctiform.

Annual or perennial grasses with linear or filiform leaves. Panicles soft, loose or contracted, of early deciduous spikelets; spikelets covered with brightly coloured, silky or silvery hairs.

Species 34, chiefly in Africa and Madagascar with two species found in India.

The type species of the genus is *R. dregeanum* Nees, which has been recognized as conspecific with *R. repens* Hubb.

Key to the species of *Rhynchelytrum*

Pedicels of the spikelets with a few long hairs; lower glume .6 mm. below the upper, bearded at the base, elsewhere pilose.	1. *R. repens.*
Pedicels of the spikelets without long hairs; lower glume .8 mm. below the upper, bearded at the base, glabrescent upwards.	2. *R. villosum.*

1. *Rhynchelytrum repens* (Willd.) C. E. Hubbard* in Kew Bull. (1934) 110. This plant is based upon the *Saccharum repens* of Wildenow, Sp. Pl. I (1798) 322. The grass appears in the Flora of Tropical Africa IX (1930) 880 as *Rhynchelytrum roseum* (Nees) Stapf et Hubbard,. who made this combination in Bews J. W. The World's Grasses (1929) 223, based on *Tricholaena rosea* Nees, Cat. Sem. Hort. Vratisl. (1835), and in Linnaea XI. Lit. Ber. (1837) 129 (in part).

An annual or perennial tufted grass. Culms most often erect but sometimes geniculate at the base and then rooting from the lower nodes, up to 1 m. tall, simple or branched, glabrous and smooth or pubescent with hairs arising from very small tubercles. Leaf-blades linear, tapering to a fine point, 5-30 cm. long, 2.5-12.5 mm. wide, glabrous or pubescent, flat or folded, green or glaucous, smooth below, rough towards the tips; leaf-sheaths tight or loose, terete, finely striate, smooth or slightly rough to the touch, glabrous or hairy, hyaline on the margins; ligule a ciliate rim with cilia up to 1.5 mm. long.

Inflorescence an oblong, ovate or pyramidal panicle, 5-20 cm. long, dense or lax, often flexuous, silky-hairy, cream, silvery-white or purplish red in colour. Central rachis terete, slender, striate, sometimes channelled on one side, glabrous with a few long hairs at the nodes, smooth or minutely rough; branches 1-2 at each node, branching and rebranching shortly above the base, spreading or ascending; branches and branchlets finely capillary, smooth or most minutely rough, often flexuous, sometimes coiled, ending in discoid tips, bearing one or a few long hairs just below the spikelets; hairs silky, white, crimson or variegated white and crimson up to 6 mm. long. Spikelets 3-5 mm. long, ovate to broadly oblong, usually gaping, greyish brown or dark brown, usually with the beaks (lips of upper glume and lower lemma) darker than the rest of the spikelets, silkily-hairy with cream-coloured or reddish-purple hairs. Lower glume linear or oblong in shape, rounded, truncate or emarginate at the top, 1-2 mm. long, densely bearded at the base, and pilose over the back; upper glume 0.6 mm. above the lower, 3-5 mm. long, cymbiform, narrowly to broadly semi-ovate in profile, usually

* In Kew Bull, No. 2, 1941, 190 C. E., Hubbard cites this plant as *Rhynchelytrum repens* (Schumach.) C. E. Hubbard.

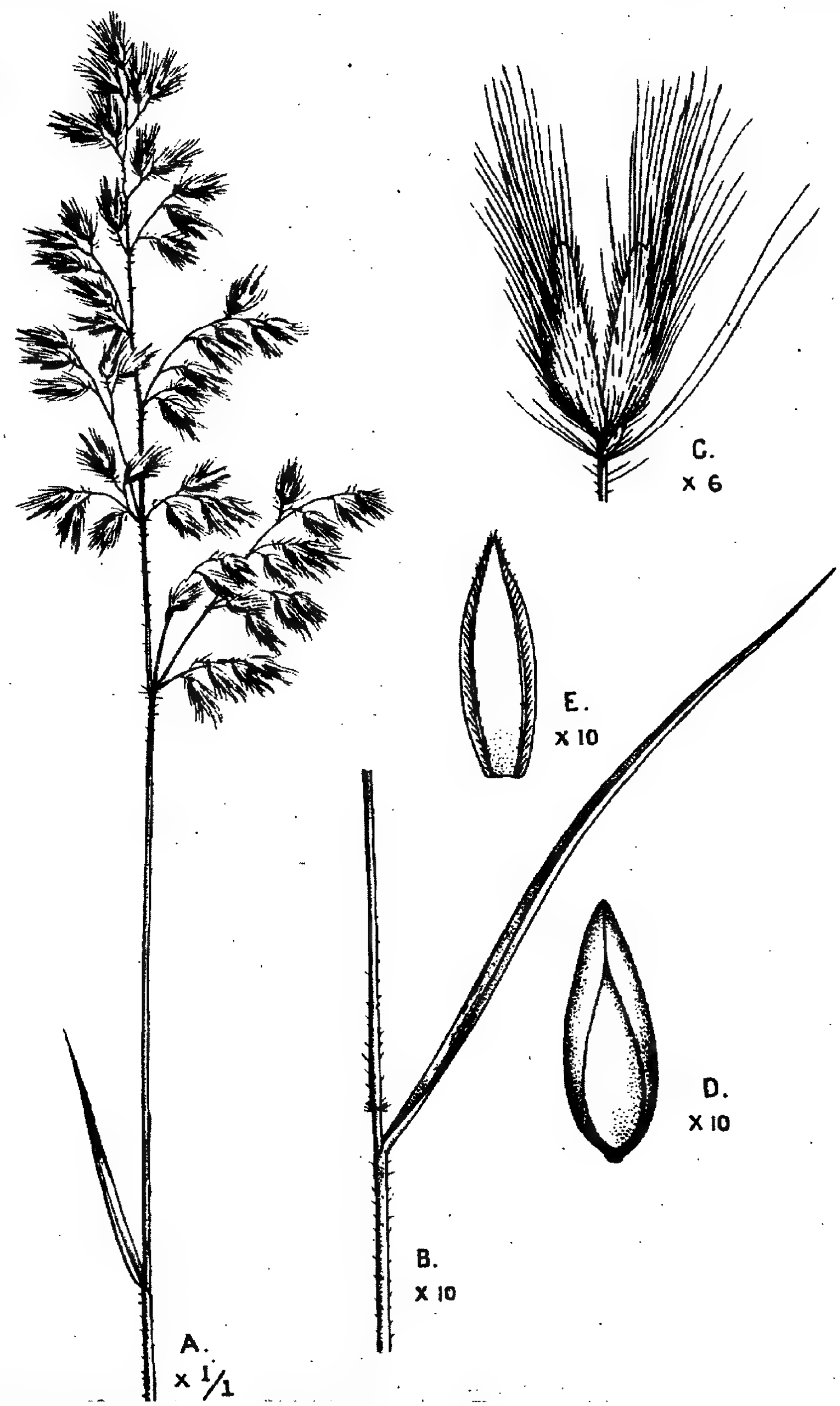
conspicuously gibbous below the middle, tapering upwards into a long or short beak, which is divided at the top into two short obtuse lobes, from between which issues an antrorsely scabrid awn up to 5 mm. long, firmly chartaceous in texture, 5-nerved, covered with white, reddish-purple silky hairs, longest in the middle third of the back of the glume; hairs exceedingly by far the length of the glume. Lower floret male or barren; lemma the same size and of the same texture as the upper glume, usually narrower and less gibbous; palea linear, about one-third shorter than the lemma, minutely 2-lobed at the tip, 2-keeled, hyaline; keels densely ciliate. Upper floret hermaphrodite; lemma thinly chartaceous in texture, finely 5-nerved, translucent, elliptic or elliptic-oblong when flattened, notched at the apex, 2.5 mm. long, palea of the same texture as the lemma and as long, not keeled. Stamens 3; anthers 2 mm. long. Grain 1.8 mm. long.

This grass is sometimes called Natal grass and also Red Top. It is widely dispersed in Tropical Africa and is also found in Arabia and South Africa. It has been distributed all over the world as a fodder grass. It has become naturalized to some extent in India and is found in Assam and the Central Provinces. It is sometimes grown in gardens on account of the reddish silky spikelets which are a very effective decoration when massed. As a fodder it has a reputation in Africa which has not been maintained when cultivated outside its natural home. It thrives in dry sandy places.

Plate 28. *Rhynchelytrum* repens (Schumach.) C. E. Hubbard.

A. Inflorescence.
B. Portion of the culm.
C. Spikelet and pedicel.
D. Upper lemma and palea.
E. Palea of the lower floret.

2. *Rhynchelytrum villosum* (Parl.) Chiov. in Ann. Instit. Bot. Roma, VIII. 310. Syn. *R. wightii* Duthie, Fodd. Grass. N. Ind. 21; *Tricholaena wightii* Arn. and Nees in Linnaea, XVI, 218 (nomen nudum); Hook. f., Flor. Brit. Ind. VII, 65; Blatter and McCann., Bombay Grasses, 176. The first name given to this species was *Monachyron villosum* Parl. in Hook. Niger Fl. (1849) 191, hence the specific epithet *villosum* has priority over *wightii* which in combination with *Tricholaena* is a nomen nudum.



Rhynchelytrum repens (Schumach.) C. E. Hubbard.

An annual or sometimes a perennial grass. Culms erect or geniculately bent at the base, up to 100 cm. tall, simple or branched, often sheathed to just below the inflorescence, where visible sparsely to densely hairy, or glabrous, smooth or rough below from the tubercular bases of the hairs. Leaf-blades linear, shortly rounded at the base, flat, folded or rolled, tapering to an acuminate tip, up to 15 cm. long and 8 mm. wide, glabrous and smooth or sparsely or densely pilose with hairs arising from tubercle bases, in addition to which there are numerous very short hairs on the nerves; margins often tubercular with hairs arising from the tubercles; sheaths terete and tight, or loose and falling from the stems, striate, glabrous and smooth, or bristly with tubercle-based hairs, often enclosing the mature inflorescence, the upper with reduced limbs; ligule a densely ciliate rim.

Inflorescence a lanceolate or broadly ovate panicle, erect or nodding, loose or contracted, 5-15 cm. long, 2-6 cm. wide, shining, often enclosed in the upper leaf-sheaths; central axis rough and striate, smooth, glabrous or pubescent; branches 2-3 from the nodes or solitary, sparingly branched; ultimate branchlets very flexuous, sometimes coiled; pedicels 1-6 mm. long, with dilated, pubescent or pilose tips. Spikelets 5-6 mm. long, deciduous entire from the discoid tips of the pedicels, oblong in shape, gaping, brown or yellowish in colour, villous with reddish-purple, or silvery-reddish hairs, occasionally hairs arising from tubercular bases. Glumes distant from one another by 0.5-1 mm.; lower oblong in shape, truncate, rounded or notched at the tip, 1.5-1.75 mm. long, brown in colour, densely bearded at the base with hairs half its length; minutely hairy or glabrescent upwards; upper boat-shaped, conspicuously gibbous below the middle, 5-6 mm. long, lanceolate to semi-ovate in profile, tapering upwards into a narrow, shortly and obtusely two-lobed beak, coriaceous in texture, 5-nerved, brown in colour or pale yellow with dark-brown nerves, villous especially on the keel and upper half of the margins where the hairs in the middle third or fifth are as long as the glume, shortly hairy on the sides, ciliate on the margins below; hairs spreading or appressed, silvery-reddish-purple or silvery-brown in colour, awned from the sinus of the 2-lobed tip with an antrorsely scabrid awn up to 10 mm. long. Lower floret male or barren; lemma as long as the lower glume and

very similar to it, but narrower and much less gibbous, hairy, often only slightly curved on the back; palea linear-lanceolate in shape, 3 mm. long, ciliate on the keels. Upper floret hermaphrodite; lemma rounded on the back, thinly chartaceous in texture, up to 2.5 mm. long, finely 5-nerved, ovate-elliptic when flattened; palea narrowly ovate-elliptic in shape, as long as the lemma and of the same texture, 2 nerved, not keeled. Stamens 3; anthers 1.5 mm. long.

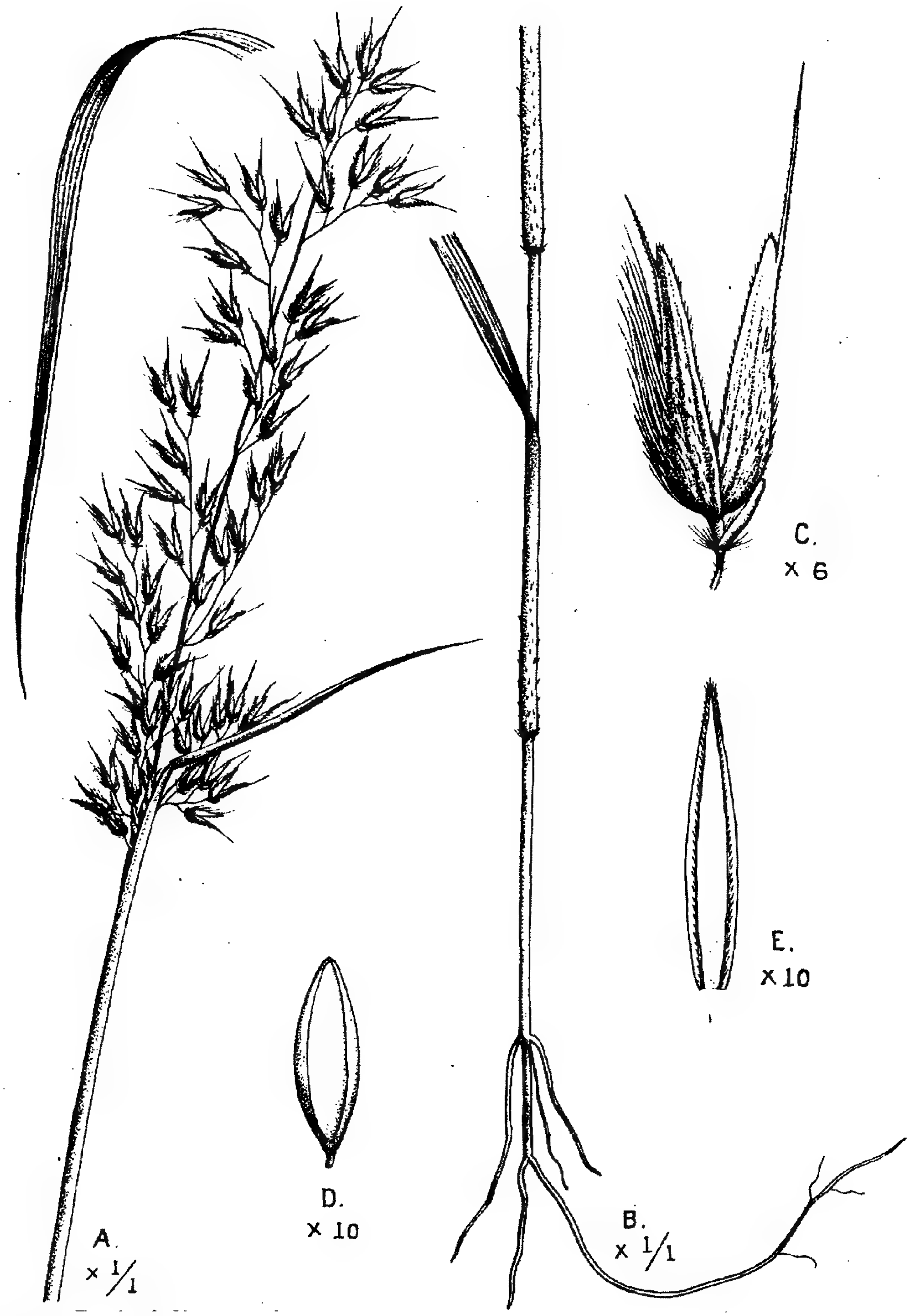
This grass is found in Madras, Bombay, the Punjab, Rajputana, Arabia and Tropical Africa. It is considered a doubtful indigenous plant as it is so often cultivated in gardens.

Plate 29. *Rhynchelytrum villosum* (Chiov.), Parl.

A. Panicle.
B. Portion of the culm and root system.
C. Spikelet and pedicel.
D. Upper lemma and palea.
E. Palea.

2. *Tricholaena* Schrad.

Spikelets oblong or ovate-oblong in outline, slightly laterally compressed, but not keeled or keeled only at the tips, silkily hairy, falling entire from the discoid tips of capillary pedicels which are the ultimate branchlets of a loose or contracted panicle, 2-flowered. Florets dissimilar; the lower male, the upper hermaphrodite. Glumes very different, closely approximate; lower an orbicular or oblong hyaline scale, small, often obsolete, long-pilose with fine white hairs; upper as long as the spikelet, obliquely dimidiate-lanceolate or lanceolate-oblong in profile, ovate to elliptic-oblong when flattened, acute at the tip, finely five-nerved, usually mucronate, long and silky-pilose on the rounded back, ciliate on the margins. Lower floret male; lemma somewhat similar to the upper glume in shape, profile, texture and indumentum, but broader and more obtuse; palea linear to lanceolate, hyaline, 2-keeeled, notched at the apex, ciliate on the margins and keels. Upper floret hermaphrodite, smaller than the lower, sometimes deciduous before the rest of the spikelet, lanceolate to ovate-lanceolate in outline; lemma smooth and shining, pale-yellow in colour, firmly chartaceous, coriaceous to crustaceous in texture, finely 5-nerved, glabrous:



Ganga Singh

Rhynchelytrum villosum Chiov.

palea of the same colour and texture as the lemma and only slightly shorter, 2-nerved, rounded on the keels. Lodicules two, minute. Stamens three. Styles distinct; stigmas plumose, exserted at the sides of the floret near the apex. Grains ovate-oblong or elliptic-oblong in outline, slightly dorsally compressed, tightly enclosed by the lemma and palea; scutellum half the length of the caryopsis; hilum basal, punctiform.

Perennial, rarely annual grasses with rigid branched stems; leaves rigid, involute, glaucous; inflorescence a loose or contracted panicle.

A genus containing about eight species in Africa, Canaries, Sicily, South-west Asia, Arabia and North-west India.

Type species of the genus *Tricholaena teneriffae* Parl.

Tricholaena teneriffae (Linn. f.) Parl. in Webb and Berth. Hist. Nat. Iles. Canar. III, (1848), 425; *Saccharum teneriffae* Linn. f. Suppl. 106.

A perennial grass. Culms usually erect but sometimes geniculately ascending from a woody rootstock, emitting a bunch of fibrous roots, up to 50 cm. tall, slender, smooth, pubescent on the lower nodes, otherwise glabrous, terete, branched especially at the base, nodes rather close together below. Leaf-blades linear, 3-8 cm. long by 1.5-3 mm. wide, tapering to a finely acuminate tip, convolute, rigid, glabrous, or the upper surface sparsely pubescent, smooth on the surfaces and on the margins; sheaths terete, striate, smooth, glabrous, tight or sometimes the lower loose and slipping from the culms; lower becoming crustaceous and brittle, occasionally somewhat hairy above the nodes; ligule a densely, but softly, hairy ridge.

Inflorescence a slender erect panicle oblong or ovate, loose or contracted, 6-12 cm. long; rachis slender, angled, flexuous, glabrous or hairy at the nodes, absolutely smooth; branches in pairs or 3 or 4 from the nodes, flexuous, slender, smooth and glabrous, branching once or twice, the ultimate pedicels ending in flat discoid tips. Spikelets up to 4.25 mm. long, silky with white appressed or spreading hairs sometimes arising from minute tubercles, ovate or ovate-oblong in shape, gaping, falling entire from the discoid tips of the pedicels. Lower glume orbicular or oblong, from almost

obsolete up to 0.6 mm. long, slightly remote below the upper glume long villous with hairs up to 5 mm. long; upper glume as long as the spikelet, dimidiate-lanceolate or linear-lanceolate in profile, ovate when flattened, acute at the tip, finely 5-nerved, usually mucronate, loosely long-villous with hairs up to 6 mm. long, ciliate on the margins. Lower floret male (or neuter?) as long as the spikelet; lemma similar to the upper glume but broader, dimidiate-ovate or lanceolate in profile, elliptic-ovate when flattened, usually mucronate; palea hyaline, lanceolate-oblong in shape, obtuse, 2-keeled, ciliate on the keels, with infolded margins, margins of flap ciliolate above the middle. Upper floret hermaphrodite; lemma 2-2.5 mm. long, ovate-oblong or lanceolate-oblong in shape, firmly chartaceous or coriaceous in texture, shining and polished, smooth and glabrous; palea as long as the lemma and of the same texture, rounded on the angles; margins infolded. Stamens three; anthers 2 mm. long. Style 2; stigmas plumose, exserted at the sides of the floret.

A grass with a wide distribution, being found in the Punjab, Sind, Baluchistan, Afghanistan, Arabia, Palestine, Italy, Canary Islands and in Tropical Africa. It appears to be at home in desert areas.

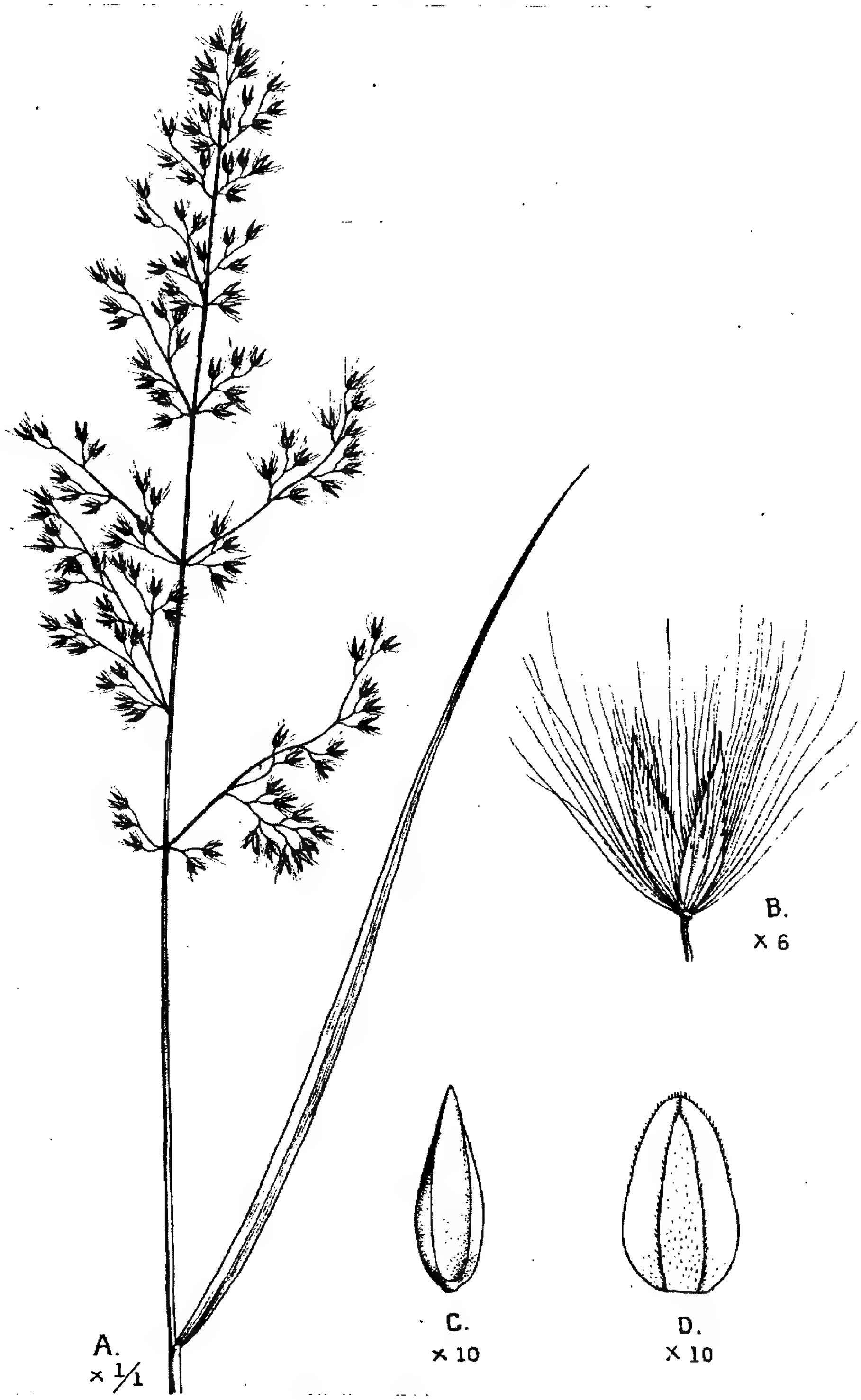
Plate 30. *Tricholaena teneriffae* Parl.

A. Panicle.

B. Spikelet and pedicel.

C. Upper lemma and palea.

D. Palea.



Ganga Singh

Tricholaena teneriffae Parl.

NOTE ON THE SEED OF *HARDWICKIA BINATA*

By V. R. Kamalapur

There are a few *anjan* (*Hardwickia binata*) trees in the forests of Bhamburda in the vicinity of Poona. These trees appear to have been planted some thirty years ago. This species has also been planted in different localities in the Satara District. The trees in both the Poona and Satara Divisions from their size appear to have been introduced about the same time, but they did not appear to produce any seed. This peculiar phenomenon caused me to keep a close watch over their fruiting. The trees were observed to bear flowers and fruits for the first time in 1939. This unusually delayed fruiting would appear to indicate that this tree having been taken from its home in Khandesh where the temperature rises up to 112° F, did not find the change of locality congenial to itself.

I was closely watching the fruiting of this species with a view to collecting the maximum quantity of seed from the trees in this area. Seeding was watched this season and the seed was noticed to be tender until the month of March. While collecting the pods about the 28th of that month I was surprised to see the fruit with the seed fixed at the edge eaten away, bearing a slit on the edge of the pod. Normally, a forest subordinate may mistakably collect this as the seed itself. On closer observation of the locality round about the trees, it was noticed that the remains of the seeds eaten by the birds were lying on the ground. There were some pods which were not yet touched by the birds. On examination some of these pods were found to be quite ripe. This points to the necessity of collecting the seed immediately it is ripe to prevent its being eaten by the birds. The seed so eaten, and the pod with slit were immediately sent to the Divisional Forest Officer, Poona, for his examination.

STATEMENT OF WILD ANIMALS SHOT IN SOME OF THE INDIAN

All-India serial number.	Species.	Ajmer-Merwara.	Assam.	Bengal.	Bihar.	Bombay.	C. P. and Berar.
1a	Tiger ..	..	13	12	5	12	105
1b	Tigress ..	..	5	24	..	10	..
2	Leopard or panther ..	1	1	28	7	46	71
3	Wild cats (species to be given if known)	..	..	19	..	..	..
4	Lynx ..	..	..	..	..	..	..
5	Hunting leopard or cheetah	..	..	..	..	..	..
6	Hyena ..	..	..	..	..	..	11
7	Wolf ..	..	..	..	..	..	..
8	Wild dog ..	..	..	5	..	..	22
9	Martens ..	..	..	..	..	..	..
10	Ratel ..	..	..	..	..	..	..
11	Brown bear ..	2 (bears)	..	..	..	..	..
12	Himalayan black bear ..	..	..	..	..	..	
13	Malayan bear ..	..	..	..	..	..	35
14	Sloth bear ..	..	..	5	2	13	
15	Wild elephant ..	..	71	39	1	30	..
16	Rhinoceros (species to be given)	..	2 R. unicornis	..	..	..	..
17	Gaur or bison ..	..	..	..	1	23	10
18	Goyal or mithan ..	..	..	..	..	..	..
19	Banting or tsine ..	..	..	..	..	..	..
20	Wild buffalo ..	..	2	..	..	..	..
21	Urial or sharpu ..	..	..	..	..	..	..
22	Bharal or blue sheep ..	..	..	..	..	..	..
23	Ibex ..	..	..	..	..	..	..
24	Markhor ..	..	..	..	..	..	..
25	Tahr ..	..	..	..	..	..	..

PROVINCES, INDIAN STATES AND BURMA DURING 1940-41

Coorg.	Madras.	Orissa.	Punjab.	Sind.	U. P.	Jammu and Kashmir State.	Burma including Federated Shan States.
9	4	3	..	..	76	..	66
..	2		2	..	35	..	..
2	8	11	22	..	89	35	58
..	6	..	12	..	22	..	..
..	..	..	..	..	..	..	..
24	2	..	..	..	..	..	..
..	..	1	..	..	15	..	..
..	..	..	..	..	..	49	..
4	46	1	2	..	11	..	137
..	..	..	..	..	18	..	..
..	..	..	..	..	..	..	..
1 (bear)	1	..	7	..	..	3	207 (bears)
..	..	..	15	..	5	43	..
..	..	..	..	..	..	..	..
..	4	4	..	..	29	..	..
2	3	1	..	..	..	..	413
..	..	..	..	..	..	..	..
2	9	..	..	..	..	..	30
..	..	..	..	..	..	1	31 (saing)
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	13	..	..	5	..
..	..	..	..	..	..	1	..
..	3	..	1	..	..	13	..
..	..	..	..	..	..	3	..
..	..	..	..	..	..	3	..

Statement of Wild Animals Shot in some of the Indian

All-India serial number.	Species.	Ajmer-Merwara.	Assam.	Bengal.	Bihar.	Bombay.	C. P. and Berar.
26	Nilgiri wild goat or Nilgiri ibex	..	..	..	..	..	..
27	Serow or Himalayan goat-antelope	..	..	4	..	..	..
28	Goral ..	..	..	4	..	..	..
29	Nilgai or blue bull ..	..	..	..	2	81	99
30	Four-horned antelope ..	..	..	..	..	..	..
31	Black buck ..	..	..	..	..	..	
32	Indian gazelle or chinkara	..	..	..	..	1	85
33	Barking deer or kakar ..	..	10	150	3	8	
34	Kashmir stag or hangul	..	..	..	..	..	..
35	Swamp deer or gond or barasingha	..	..	..	..	..	1
36	Brow-antlered deer or thamin	..	..	..	..	..	..
37	Sambar ..	..	4	45	17	13	108
38	Cheetal or spotted deer or axis deer	..	..	630	5	11	137
39	Hog deer or para ..	..	10	22	..	..	..
40	Musk-deer ..	..	..	..	..	..	..
41	Mouse-deer ..	..	..	..	..	..	..
42	Pangolin ..	..	..	..	..	..	..
43	Crocodile (muggar) ..	..	..	..	..	..	3
44	Gharial ..	..	..	1	..	..	..
45	Python ..	..	..	2	..	..	..
46	Others (species to be given)	2 (pigs)	33 (pigs)	396 (338 pigs, 51 hares, 1 porcupine, 1 monkey, 5 snakes).	7 (4 pigs, 3 hares).	707 (pigs)	654 (pigs)

Provinces, Indian States and Burma during 1940-41.—Concluded

Coorg.	Madras.	Orissa.	Punjab.	Sind.	U. P.	Jammu and Kashmir State.	Burma including Federated Shan States
..	6	..	..	..	..	..	..
..	..	..	..	..	1	..	..
..	..	..	47	..	17	4	..
..	..	2	18	..	74	..	..
..	..	2	..	..	1	..	..
..	1	..	..	..	4	..	..
..	..	..	..	..	..	..	..
..	9	5	6	..	71	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	14	11	..
..	..	..	..	..	..	..	2
..	27	13	..	..	131	..	..
4	19	5	..	..	244	..	..
..	..	..	..	5	13	..	..
..	..	..	9	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	9	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	5	..	..
5 (1 pig, 4 jungle sheep.)	7 (1 pig, 6 mangooses)	13 (4 pigs, 9 hares).	68 (60 pigs, 5 porcupines, 3 hares).	45 (pigs)	1,335 (otters, porcupines, pigs, etc.)	3 (otters)	..

SOME COMMON FODDER-YIELDING TREES IN THE MADRAS PRESIDENCY—II.

BY S. N. CHANDRASEKHARA IYYAR, M.A., *Lecturer in Botany*

and

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39. *Ficus glomerata* Roxb. Fam: *Moraceae* (country fig.).

Tam: *atthi;* Tel: *atthi;* Mal: *atthi;* Kan: *atti.*

A large deciduous tree with few and short aerial roots. Bark grey to reddish brown. The leaves are readily eaten by cattle, sheep and goats and the fruits which fall to the ground when ripe are edible. The unripe fruits are used as a vegetable.

Distribution.—Common in all districts from sea level to about 6,000 feet.

Propagation.—By seeds and stumps; a very good avenue and shade tree.

40. *Ficus infectoria* Roxb. Fam: *Moraceae.*

Tam: *malai-ichchi;* Tel: *jati juvi;* Mal: *cherla;* Kan: *basari.*

A large deciduous tree without aerial roots. Bark greenish grey, smooth, wood grey, moderately hard. The leaves are eaten by cattle, sheep and goats.

Distribution.—In all districts from sea level to 7,000 feet; frequently planted near and in villages.

Propagation.—By seed and stump planting; a very good avenue and shade tree.

41. *Ficus religiosa* Linn. Fam: *Moraceae* (*pipal* tree):

Tam: *arasa, arasu;* Tel: *ragi, ravi;* Mal: *arasu;* Kan: *arali aswatham.*

A large tree with few or no aerial roots; produces a large amount of foliage which is readily eaten by cattle, sheep and goats. In places where the plant occurs in large numbers, the cultivators cut down the branches with the leaves and take them home for feeding their cattle.

Distribution.—The plant is not wild in Southern India but widely planted on village sites and as avenue tree.

Propagation.—By seeds and stumps; a very good avenue and shade tree.

42. *Ficus retusa* Linn. Fam: *Moraceae.* Hind: *barri.*
Tam: *pon-ichchi;* Tel: *konda juvi;* Mal: *ittiyal;* Kan: *pilala.*

A large evergreen tree with few aerial roots. Bark brown and fairly smooth. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—In all districts from sea level to about 4,000 feet. Sometimes planted in avenues.

Propagation.—By seeds and stumps; a good avenue and shade tree.

43. *Ficus Tsiela* Roxb. Fam: *Moraceae.*
Tam: *kal-ichichi;* Tel: *pedda-juvi;* Mal: *kirgali;* Kan: *billibasara.*

A large spreading tree with few or no aerial roots. Bark greenish grey and smooth. Produces plenty of foliage which is readily eaten by cattle, sheep and goats.

Distribution.—From Kurnool southwards, in deciduous and evergreen forests from 1,000 to 3,500 feet. Frequently planted in avenues and for shade.

Propagation.—By seeds and stumps; a very good avenue and shade tree.

44. *Gmelina arborea* Roxb. Fam: *Verbenaceae. Hind. Sewan.*
Tam: *gumadi, umi;* Tel: *gumar tek;* Mal: *kumbil;* Kan: *shivani.*

A fairly large deciduous tree with handsome panicles of brownish yellow flowers and large yellow fleshy drupes. Bark smooth, whitish-grey, wood greyish-white, hard and useful for furniture. The fruits and leaves are eaten by cattle, sheep and goats.

Distribution. In all districts in deciduous forests up to 5,000 feet; often planted in avenues and gardens.

Propagation.—By seeds; can be planted in avenue and gardens.

45. *Guazuma tomentosa* Kunth. Fam: *Sterculiaceae.*

A small tree with obliquely cordate leaves and yellow flowers in large terminal and axillary panicles. The leaves are eaten by cattle, sheep and goats. The ripe fruits which are black and are of the size of a large marble are edible and relished especially by children.

An introduced tree, often found run wild usually in the vicinity of towns and villages, indigenous in tropical Africa.

Propagation.—By seeds; can be planted in gardens and avenues, and also serves well as a hedge plant.

46. *Hardwickia binata* Roxb. Fam: *Leguminosae.* Hind: *anjan.* Tam: *acha, kattudugu;* Tel: *yepi;* Kan: *kamra.*

A large deciduous tree with small yellowish flowers. Bark dark-grey and rough; wood extremely hard, dark-red and useful for making agricultural implements. The leaves are cut for manure and the branchlets for the fibre of their bark. The leaves form a good fodder for cattle, sheep and goats.

Distribution.—Deccan and Carnatic, in the Upper Godavari forests, Kistna and Guntur, in the Ceded districts, Mysore, Coimbatore and Salem, often forming gregarious forests.

Propagation.—By seeds; can be planted in waste places and tank bunds.

47. *Holoptolea integrifolia* Planch. Fam: *Ulmaceae* (Indian elm). Tam: *aya, ayil, tambachi;* Tel: *thapasi, nauli;* Mal: *aval,* Kan: *thavasai.* Hind: *papri.*

A large deciduous tree. Bark whitish grey. The leaves and young pods are eaten by cattle, sheep and goats.

Distribution.—N. Circars in deciduous forests, in the hills of Deccan, Eastern slopes of Western Ghats and low levels of Travancore; often planted as an avenue tree.

Propagation.—By seeds; can be planted in the avenues and waste places.

48. *Kydia calycina* Roxb. Fam: *Malvaceae.* Hind: *pula.* Tel: *potri;* Kan: *bendi.*

A moderate-sized, quick growing tree with white soft wood. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—Most districts in N. Circars and Deccan, in deciduous forests.

Propagation.—By seeds; can be planted in waste places.

49. *Lagerstroemia Flos-Reginae* Retz. Fam: *Lythraceae.*

Tam: *kadali, pumaruthu;* Mal: *mani maruthu.* Beng: *jarul.*

A large deciduous tree with handsome large mauve flowers and large seed capsules. Bark smooth, usually grey; wood light-red, hard, valuable for building, for shipwork and furniture. The leaves are eaten by cattle, sheep and goats.

Distribution.—Hills of N. Circars; W. Ghats, from S. Kanara to Travancore, chiefly along river banks and up to 3,000 feet; often planted for ornament and for timber.

Propagation.—By seeds; a good avenue and ornamental tree.

50. *Mangifera indica* Linn. Fam: *Anacardiaceae* (mango).

Tam: *maa;* Tel: *mamidi;* Mal: *mavu;* Kan: *mavu, mavina.*

A large spreading evergreen tree reaching 50 feet in height, cultivated for its edible, very important fruit. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—Hill forests of E. Ghats, Deccan and W. Ghats up to 4,000 feet. Universally cultivated in gardens, avenues and often run wild.

Propagation.—By seeds and grafts; a good avenue, shade and fruit tree.

51. *Morinda tinctoria* Roxb. Fam: *Rubiaceae.*

Tam: *nuna, nona;* Tel: *maddi togari;* Mal: *manchapavatta.*

A moderate-sized deciduous tree. The leaves are eaten by sheep and goats.

Distribution.—South Deccan and Carnatic to South Travancore in dry forests. Scattered in many districts.

Propagation.—By seeds; can be planted in waste places.

52. *Moringa oleifera* Lam. Fam: *Moringaceae* (horse radish tree).

Tam: *moringa;* Tel: *munaga;* Mal: *moringa;* Kan: *nugge mara.*

A medium-sized tree with grey bark and soft white wood. The tender fruits are eaten as a vegetable and the seeds give luminant

oil. The tender shoots and leaves are very much relished by cattle, sheep and goats and are said to increase the flow of milk in cows.

Distribution.—N. Circars, in Ganjam and Godavari; cultivated throughout the presidency in villages and towns and run wild.

Propagation.—By seeds and stump planting; can be planted in gardens.

53. *Odina Wodier* Roxb. Fam: *Anacardiaceae.*

Tam: *wodier, odiyamaram;* Tel: *gumpini, oddhi;* Kan: *crodda, geru;* Mal: *annakara, kalasan.* Hind: *kaimal.*

A fair-sized tree with thick bark and reddish brown wood. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—In deciduous forests in most districts, often planted in avenues.

Propagation.—By seeds; can be planted in avenues and gardens.

54. *Ougeinia dalbergioides* Benth. Fam: *Leguminosae.*

Tel: *tella motku, tella moduga.* Hind: *Sandan.*

A moderate-sized tree, very pretty in flower. Bark dark brown; wood light-brown and hard and useful for carts and implements. The leaves are eaten by cattle, sheep and goats.

Distribution.—Forests of Ganjam, Vizagapatam and Godavari; Mysore and N. slopes of Nilgiris; sometimes planted for ornament.

Propagation.—By seeds; can be planted in avenues and gardens.

55. *Pithecolobium dulce* Benth. Fam: *Leguminosae.*

Tam: *koduka puli;* Tel: *sima chintha;* Kan: *sinehunise.*

A tree which, when allowed to grow reaches a good size. Quick-growing and forms a good live fence. Pods are eaten by cattle and the foliage by the goats.

Distribution.—All plains districts cultivate as a hedge plant and run wild. A native of tropical America.

Propagation.—By seeds; can be planted in the avenues and gardens along the fence and in waste places.

56. *Pongamia glabra* Vent. Fam: *Leguminosae.*

Hind: *kanji.* Tam: *ponga, pungum;* Tel: *kanuga;* Mal: *ungumaram;* Kan: *ugge mara.*

A moderate-sized nearly evergreen tree. Bark thick, wood white, moderately hard used for cart-wheels and other purposes;

gives a large amount of foliage which is eaten by cattle and readily by goats. It is also one of the important green leaf manure plants. Seeds give an oil used in medicine and for burning.

Distribution.—Coast forests and on river banks in most districts; often planted in gardens and avenues.

Propagation.—By seeds; a good avenue and shade tree; comes up well in waste places also.

57. *Prosopis julifera* (S. W.) DC. Fam: *Leguminosae.*

The Algaroba, Mesquite, or Keawe tree, native of West Indies. The flowers are a source of honey. The leaves, shoots and pods are used to feed cattle and the pods being said to be "as nutritious as corn". The tree is a prolific yielder and is extensively cultivated in America. The tree is quick-growing and highly drought resistant, and can be grown in arid barren soils where no other crop could be grown.

Propagation.—By seeds; can be grown in pasture lands and waste places.

58. *Prosopis spicigera* Linn. Fam: *Leguminosae.*

Tam: *perumbu, vanni;* Tel: *chani.*

A moderate-sized deciduous tree with many thorns on broad bases. Bark grey, wood hard and purplish brown. The pods and leaves are eaten by cattle, sheep and goats.

Distribution.—Deccan and Carnatic, on dry stony lands and on black cotton soil in open forests.

Propagation.—By seeds; can be grown in pasture lands and waste places.

59. *Pterocarpus Marsupium* Roxb. Fam: *Leguminosae.*

Hind: *bijasal;* Tam: *vengai;* Tel: *yegi;* Mal: *venga;* Kan: *honne.*

A large deciduous tree with thick grey bark and very hard yellowish brown wood, used for building, furniture and agricultural implements. It gives a red gum-resin "Kino" used in medicine. The leaves are eaten by cattle, sheep and goats.

Distribution.—In all forest districts, chiefly in deciduous forests, up to 4,500 feet.

Propagation.—By seeds; can be grown in gardens and avenues.

60. *Pterocarpus santalinus* Linn. Fam: *Leguminosae* (red sanders).

Hind: *lal chandan;* Tam: *chivappuchandanum;* Tel: *yerra chendanum.*

A very pretty moderate-sized tree. Bark blackish brown. Wood extremely hard, dark claret-red to black and used for carvings. Leaves are eaten by cattle, sheep and goats.

Distribution.—Deccan, in the hills of Cuddapah, S. Kurnool, N. Arcot and Chinglepet, up to 1,500 feet.

Propagation. By seeds; can be planted in gardens, avenues and waste places.

61. *Schleichera trijuga* Willd. Fam: *Sapindaceae*

Hind: *kusam.* Tam: *puvan;* Tel: *puska;* Mal: *puvam;* Kan: *chakota.*

A large deciduous tree with large leaflets, which are bright-red when young. The aril of the fruit which is about 1 inch long is edible and the seeds give an oil used for burning. The bark is grey and wood hard and useful for making agricultural implements. The leaves and pods are eaten by cattle, sheep and goats.

Distribution.—In all forest districts, chiefly in deciduous forests and up to 3,000 feet.

Propagation.—By seeds; can be planted in avenues and gardens.

62. *Sesbania aegyptiaca* Pers. Fam: *Leguminosae.*

Tam: *chittakatti;* Tel: *suiminta.*

A quick-growing soft-wooded shrub, with small pink flowers. The leaflets are comparatively small and are eaten by cattle, sheep and goats.

Distribution.—Cultivated and found run wild in almost all the plains districts.

Propagation.—By seeds.

63. *Sesbania grandiflora* Pers. Fam: *Leguminosae.*

Tam: *agathi;* Tel: *avesi.*

A quick-growing small soft-wooded tree, slender stemmed, reaching 20-30 feet high, with large showy red or white flowers and

long pods. The leaves, flowers and green pods form a good cattle feed and are said to increase the yield of milk. Young leaves are also eaten as a vegetable.

Cultivated in gardens or betel-vine plantations as supports and also in sugarcane fields as windbreaks; not indigenous.

Propagation.—By seeds.

64. *Syzygium Jambolanum* DC. Fam: *Myrtaceae.*
Tam: *naval, nagai;* Tel: *neredu;* Mal: *naga;* Kan: *narala.*

A large evergreen tree with white flowers and purple edible fruit. The fruit in cultivation is oblong and in a wild state usually small and globose. Bark smooth, light grey; wood hard reddish grey and useful for agricultural purposes. The leaves are readily eaten by cattle, sheep and goats.

Distribution.—In all forests, both in the plains and in the hills up to 6,000 feet, usually along river banks and in moist localities; often cultivated in avenues and gardens.

Propagation.—By seeds; a very good avenue shade and fruit tree.

65. *Stereospermum suaveolens* DC. Fam: *Bignoniaceae.*
Hind: *padal.* Tam: *padri;* Tel: *kala goru;* Kan: *billa.*

A large tree with dull crimson flowers. Bark grey; wood hard, yellowish brown and useful for many purposes. The leaves are eaten by cattle, sheep and goats.

Distribution.—N. Circars, Deccan, W. Ghats in deciduous forests; in the hills of Mysore, Malabar and Travancore.

Propagation.—By seeds; can be planted in avenues and waste places.

66. *Streblus asper* Lour. Fam: *Moraceae* (sand-paper tree).
Tam: *pura, pirasu;* Tel: *pakki;* Mal: *parava, pareukeu;* Kan: *mitli, punjai.*

A small evergreen tree with wedge-shaped leaves. Bark soft, light grey and wood white. The rough leaves are used to polish ivory and wood and are also eaten by cattle, sheep and goats

Distribution.—Common in all districts up to 2,000 feet.

Propagation.—By seeds; can be grown in avenues and waste places.

67. *Terminalia bellerica* Roxb. Fam: *Combretaceae.*
Hind: *bahera;* Tam: *thani;* Tel: *tani;* Mal: *thani.*

A large deciduous tree with long petioled leaves. Bark bluish grey with vertical cracks; wood yellowish grey. The fruit is the Belleric myrabolam used in tanning. The leaves are eaten by cattle, sheep and goats.

Distribution.—In all districts in deciduous forests up to 3,000 feet.

Propagation.—By seeds; can be grown in all waste places.

68. *Thespesia populnea* Cav. Fam: *Malvaceae* (portia or tulip tree).
Tam: *puvarasam;* Tel: *gangareni;* Mal: *porasu;* Kan: *Huvarasi.*

A fairly large quick-growing evergreen tree with cordate entire long petioled leaves. The leaves are eaten by sheep and goats.

Distribution.—Throughout the presidency often planted in avenues near the coast.

Propagation.—By seeds and stump planting; a good avenue and shade tree.

69. *Trewia nudiflora* Linn. Fam: *Euphorbiaceae.*
Hind: *gumhar.*

A large deciduous dioecious tree and large leaves. Bark smooth, grey; wood white, soft, used for drums and carved images. Leaves are eaten by cattle, sheep and goats.

Distribution.—N. Circars, in hills up to 3,000 feet chiefly in wet places along streams. Elsewhere planted and run wild.

Propagation.—By seeds; can be planted in avenues.

70. *Wrightia tinctoria* R. Br. Fam: *Apocynaceae.*
Hind: *khirni.* Tam: *nila palai, palai;* Tel: *tella pala, pala;* Mal: *aiya pala, nila pala;* Kan: *kadnilli.*

A small deciduous tree with white flowers and narrow follicles. Bark pale, smooth, wood white useful for carving. Leaves give a blue dye and are also eaten by cattle, sheep and goats.

Distribution.—In all forest districts in deciduous forests, especially in Deccan. In W. Ghats up to 4,000 feet in the hills.

Propagation.—By seeds; can be planted in avenues, gardens and waste places.

71. *Ziziphus jujuba* Lam. Fam: *Rhamnaceae.*
Hind: *ber*; Tam: *yellande, ilandai;* Tel: *regu, reni, rengha;* Mal: *cherumali, ilanda;* Kan: *yelchi, bore.*

A low much-branched thorny tree with erect, often thick, stem and round head. Bark dark grey to black; wood reddish and hard. The fruit is edible. The leaves are eaten by sheep and goats.

Distribution.—In all districts, wild in deciduous dry forests and cultivated in and near villages and run wild on waste lands.

Propagation.—By seeds and grafts; can be grown in all waste places.

(*concluded*)

TIMBER PRICE LIST, AUGUST-SEPTEMBER, 1942

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE,

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 56-0-0 to 115-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 84-9-0 to 93-12-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 72-0-0 to 130-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Rs. 1-8-0 to 2-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 1-4-0 to 2-4-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 13-0-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
,, ..	,, ..	Punjab ..	10′×10″×5″ ..	Rs. 8-0-0 per piece.
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	Rs. 40-0-0 to 45-0-0 per ton.
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	Rs. 1-10-0 to 2-13-3 per c.ft.
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 12-0-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	Rs. 77-0-0 to 84-10-0 per ton.
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 0-12-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Assam ..	Squares ..	
,, ..	,, ..	Bengal ..	Logs ..	Rs. 50-0-0 per ton.
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	
,, ..	,, ..	Bombay ..	Squares ..	Rs. 40-0-0 to 80-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 to 1-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 61-7-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-0-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers ..	
Indian rose-wood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 70-0-0 to 160-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-4-0 to 1-8-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-10-0 to 0-14-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 103-2-0 to 197-2-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 93-12-0 to 109-6-0 per ton.
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 60-0-0 to 85-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 1-0-0 to 1-8-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bihar ..	Logs ..	Re. 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-9-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 75-12-0 to 100-0-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	
,, ..	,, ..	,, ..	B. G. sleepers	
,, ..	,, ..	,, ..	M. G. sleepers	
,, ..	,, ..	Bengal ..	Logs ..	Rs. 50-0-0 to 100-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 1-8-0 to 2-0-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers ..	Rs. 7-0-0 each.
,, ..	,, ..	,, ..	M. G. sleepers ..	Rs. 2-8-0 each.
,, ..	,, ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-12-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 1-0-0 to 2-0-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers ..	Rs. 2-8-0 to 2-12-0 each.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 350-0-0 to 895-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 2-0-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 1-0-0 to 1-4-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 0-9-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 1-12-0 to 2-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 50-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class ..	
,, ..	,, ..	,, ..	Logs 2nd class	Rs. 100-0-0 to 125-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-10-0 to 3-12-0 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-10-0 to 5-2-10 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 100-0-0 to 151-2-0 per ton. C class.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 92-0-0 to 340-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers ..	Rs. 6-0-0 each.

EXTRACTS

RECRUITMENT AND FOREST POLICY

After seventy years of forest administration in India and Burma, and nearly forty years in some of the British Colonies, it is disturbing to realize how little the importance of the forest wealth of some of the countries in question is understood in Great Britain or by the responsible administration. The general attitude of administrators is apparently that forest property, especially great areas of the tropical and semi-tropical forests, can be left to look after themselves when any period of stress, financial or otherwise, eventuates. These ideas are strongly entrenched in Government circles, particularly in London.

The present position with regard to the training of foresters is causing considerable concern. Whereas men taking certain techni-

cal degrees at universities are to complete their studies before being called up for military (or other) service, those taking a pass degree in forestry are not to be retained. This action has been taken apparently after referring solely to the Forestry Commission, which, being at present chiefly a spending department, has of necessity ceased recruiting. In reply to a recent enquiry the Ministry of Labour and National Service stated that the experience of the Central Register is that the demand for pass degree forestry men is almost non-existent. The Central Register has apparently been notified of only two vacancies for such men over the last six months and both these were offered by the Sudan Government. The position with regard to the demand for agricultural students is of course very different.

The information thus conveyed is not even accurate. At about the time of, or slightly before, the offer of the Sudan appointments, the Punjab Government was offering two appointments for men possessing forestry degrees and was unable to obtain them. Further, the Colonial Office, though much slowed down, had not ceased recruiting. The recollection there was only too vivid, as it should be in India also, of the crucial difficulties in connection with filling the ranks of forestry services after the war of 1914—18; and of the troubles which inevitably resulted from recruiting excessively large annual batches often inefficiently, because hurriedly, trained.

It may be asked, it being incontrovertible that the millions of the peasant agricultural populations are in one way or another dependent upon these great forest regions in the British Empire, whether ministers and their deputies responsible for the administration of these several countries really understand the position. The forest departments have been cut down, by allowing junior officers to join the Fighting Services and reducing annual recruitment. At the same time, it is well known that enhanced fellings are taking place to provide for military requirements. No forest, whatsoever its type, can stand this kind of treatment without serious deterioration. Moreover, such fellings, are often, in the absence of the supervision of trained and responsible forest officers, put into the hands of uncontrolled timber contractors who have no other interest than to complete their contracts at whatever the cost in destruction to the forests.

Under the British system of Colonial administration, it is constantly reiterated that we are governing the countries in the interests of the people, and that when they are ready the government will be entrusted to them. But how are the forests being treated? What will be their condition when we make over this charge? The old Colonial policy was to give a long lease of a block or blocks of forests to a big timber company which paid a royalty, usually so much per tree felled; and it was considered that such arrangements were in the interest of the development of the Colony. Many fine forests have disappeared under this treatment—but their marketable value, that is, the money resulting, mostly left the country. Take, for example, Nigeria at the present time, and the valuable Mahogany timber. Under present conditions, Government, that is, the people, obtain about £4 in royalty for a tree selling at present prices for more than £100—and much of this difference goes out of the country. Further, the forests so worked are not under the supervision of trained forest officers.

War does not stop the working of these tropical forests; it tends to enhance it. The staff requires additions, not cuts—as should be evident if the case were rightly understood, to a wide-visioned administrator. It is not a question of planning ahead. Rather it is that of fulfilling a sacred obligation to the people we govern by handing down to their successors a better heritage; and that the present profits should be spent on the people themselves.

The Secretary of State for Colonies recently said in the House of Lords: 'Not only colonial trade but also colonial development in the widest sense will inevitably have to be regulated and, controlled by Government much more than was necessary before the War.' The position of forestry in the British Colonies may be commended to the personal attention of the Secretary of State.

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FORESTRY AFTER THE WAR

BY E. A. GARLAND

Summary.—This note suggests the urgent need for comprehensive planning, on lines similar to those adopted in America under the Tennessee Valley Authority, as a preparation for peace. It also suggests reasons why forestry will have an important part to play in such planning and emphasizes the need for forest scientists to integrate their practice and particularly their research work, fully and efficiently, with the everyday life of the modest communities of the future, for the serenity and health of whose environments, forests and woodlands will be partly responsible.

Some may be inclined to count as premature, and therefore as a waste of time, any consideration of problems which will have to be faced when war is ended. The argument may be advanced that the general economic conditions, in which forestry will then have to be conducted, are all still so uncertain that speculation about its direction must necessarily be useless. Against this there is the undeniable fact that in such a very long term business as forestry, foresight at times of fundamental change must certainly be of enormous importance to the success, or failure, of the enterprize. Consider how small an angle of deflection will make all the difference between a central hit, or a total miss, at a far distant target. The objects of this note, therefore, are to draw special attention to the outline of the type of economic system of the future which seems already to be looming with sufficient clarity through the mists of war and to urge the vital need to adjust our aims as foresters accordingly.

The adjective vital in that last sentence has been selected purposely and with special reference to its exact sense. The need to adjust the aims and acts of forestry without delay is deemed vital because the whole profession of forestry may be expected to have to face a very critical period during the years which follow the end of fighting. Everywhere forest capital resources will have been depleted and in many cases may be almost entirely exhausted.* For many

* This is hardly correct for India. The latest figures show that the war supply demand for India for 1942 (the biggest demand yet) from reserved forests is under 65 per cent. of one year's normal yield. Since the beginning of the war up to date not more than about 1¼ year's yield has been felled in advance though the distribution by individual provinces is not so favourable.—*Ed.*

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years there will be little, or no, financial return to be looked for from most of the lands under forest crops and in very many cases subventions, or subsidies in some form, will be needed to get these lands back into full production. After such wholesale destruction in every direction, very many will be the urgent, competitive, claims for assistance in reconstruction. How strong can be the claim of the forests in comparison with those of the homes, hospitals, libraries and ruined farm lands? Stated in that way the chances appear poor, if looked at in the light of the economic principles in vogue before this war. It is useless to pretend that the necessity for forests received any general acknowledgment in the past. What was then, in peace, the proportionate expenditure on forestry, housing and health? But will those, or similar, economic principles still be operative in future? If they are then the aims for which thousands, or probably millions, have been fighting, even though inarticulately, will not have been achieved. It is in the faith that new and finer ideals will feed and invigorate the economic systems of the future that this war is being endured.

There is at least one feature which is already clear in the future. Every science must be integrated into every-day living Cleared of technicalities, each and every science essentially consists, through specialization, of increased accuracy in perception. Scientific methods are to the highest degree sensitive examination of facts and clear inference from them. Their application to better living simply means conscious planning. Everyone has seen how necessary this is for the base purposes of war and also the thorough, all-embracing scale to which it has to be extended for success. In accepting this principle there is now no appreciable difference between the opponents. The Nazi, Fascist and Japanese totalitarian systems have however irretrievably committed their faith to attempting the apparently quicker and more vigorous, but ultimately inevitably sterile, way of violent compulsion. The nations opposed to them have to evolve those more difficult and complicated methods which will combine efficient, co-ordinated planning with individual freedom and initiative. The details of how this might best be done are beyond the scope of present considerations, but the broad basis is most relevant. The whole trend of leading thought, on our side, is that the objective of future planning will

be to build up afresh sound organic societies, which can only be achieved on the basis of primary units which are themselves sound in the widest biological sense. Only sound organisms, or units, have genuine cohesive power. Such planning will cover every sort of social, political and economic aspect. In such planning and for such purposes the science of forestry has an important part to play, because the motive will be to plan for plenty, instead of for profit and for well-being, instead of for wealth.

With plenty instead of profit as the aim, success or failure cannot be assessed in money yield. Similarly planning for any project will not consider financial capital required so much as the expenditure of real productive energy (of "ergs", to use a term popularized some years ago in America). Tests of worth will consequently be assessed in the relationship between "ergs" used up and the intensity of consumers' demand for the various goods which it is possible to produce. Scientific planning, however, also emphasizes the need to direct "consumers' choice". Plenty is as much the antithesis of luxury as is simplicity. Well-being does not consist in being able to choose among an ever-increasing multiplicity of geejaws and distractions. Setting that aspect aside however, which required reference, but need not be pursued here, timber as a crop assessed in "ergs" plainly has notable claims. Its many uses, acknowledged since time immemorial, have been in recent years and are still being, greatly extended by scientific investigations. The consumption of productive energy required to establish it is very small in comparison with all other crops and when established it is unique in its ability to restore, maintain and increase the productive energy of the soil on which it grows. Comparative research work on these lines is, however, still needed and would yield valuable results.

Well-being requires more than plenty. It means abundance of power for living and of joy in living. It means health, mental as well as physical. A relevant and damnatory commentary on the economic systems ruling before the war is that in the British Isles the bill for sickness was calculated at 270 million pounds sterling a year, though the farmers only received for their gross output barely 250 millions. Health is not obtainable by the free supply of medicines but rather in the conditions of environment. That forests and

woodlands really make an essential contribution to the full health, or stamina, of the human individual in particular, but also of all the units composing the human environment, no more precise proof can at present be given than is possible in assessing the importance of the character of diet. In both cases their sphere of influence is on the border line between physical and spiritual health. Scientific investigation has however already shown, in the case of diet, that in the West, in spite of the generally higher wages earned, the diets of innumerable workers in "centres of civilization" are definitely inferior to those regularly consumed by more "primitive" peoples. We can be thankful that there is also, at last, some extensive and growing appreciation of the fact that man is a part of his environment and that true human health is obtainable only in a truly healthy environment. Reasonable planning can only be commenced on the basis that man is a part of nature: not a demi-god outside nature. Man has to realize that he cannot claim any quasi-creative position and must abandon his ridiculous and arrogant assumption that the world was created for his sole benefit. He must plan for his environment before he can usefully plan for himself, so that the world becomes a better place for living for man, bird, beast and fish. His isolated, condescending, or even wilfully blind, attitude up to now has only made it more foul instead of more fair for all. Plenty limited by simplicity will suffice. There is no known limit to health. The scope of man's mind, the range of his perceptions, can in no way be better employed than in enabling him to relate himself to his environment. What is the effect of growing timber crops on the environment? Timber as a crop is unique in the time taken to reach maturity. One, or even two, hundred years are quite usually required. Consequently, timber crops acquire a degree of permanence in their locality equalled perhaps only in a few, and not necessarily economically sound, cases by some pastures. This makes the intrinsic nature of forests and woodlands of as great, or perhaps even greater, importance in the health of their locality than their produce. This influence by the intrinsic nature of forest crops is not one affecting only the soils on which they are raised, as, speaking generally, is the case with agricultural crops. Nor does it lie only in their physical effects in regulating the forces of wind and rain. There is a larger influence

on the environment, which man's senses can appreciate, but to which the detailed methods of scientific assessment have not hitherto been sufficiently applied. That forests and even small woodlands have a very definite influence on man's mental and, consequently, on his physical condition, is a fact of experience, even though not yet scientifically assessed. They provide essential harbourage for many birds and beasts. For man, perhaps, their greatest service is in inducing a sense of serenity. Serenity is akin to the fruits of leisure: leisure to ponder and to appreciate, without which full mental health is certainly unobtainable. When man understands more fully the needs of his environment, he may come to realize that the part which forests and woodlands have in natural resources is parallel to and as essential as leisure in human resources.

For many years countries advanced in forestry practice have managed their forests and woodlands under forest working plans. Almost all these plans, however, have been directed to obtaining the maximum financial yield, though subject in most cases to the maintenance of the productive capacity of the soil. America has also planned for development of holiday camps in forests. Probably no country has hitherto planned its forests primarily for the development of maximum permanent employment; nor as an integral part of the environment of healthy communities, capable of producing locally as far as possible the simple plenty of all sorts necessary for well-being. Forest working plans have generally heretofore, as a consequence of the ruling financial aspects of economics, concentrated rather on wholesale disposal of their produce often for export to more or less distant markets where timber was scarce and prices, consequently, relatively high, rather than on local retail uses. With the assessment of land values in "ergs" balanced against consumers' needs, giving at the same time full consideration to the need for maximum health of the environment, many localities will tend to devote lands to timber crops which have formerly produced poor agricultural crops only by an unjustifiable expenditure of productive energy. Simultaneously, hitherto sparsely inhabited forests will be saturated with small communities, because scientific knowledge has already reached a stage which makes a new plan of social living possible as well as desirable. Aviation, radio electrical

communications and hydro-electric power now make it possible to distribute population at a high level of productive capacity without the disabilities of cultural isolation and in conditions best suited to develop the health and serenity of small communities. Human nature was already beginning to rebel before the war from the illusive benefits of "luxury" stores, "luxury" cinemas and "luxury" flats in barren streets, which denied all real privacy or serenity of life, the satisfactions of parenthood and the congenial conditions of living, in work and leisure, obtainable in modest communities. That changes on these lines are inevitable seems clear, to quote one of many proofs, from the fact that health services in American cities of over one million souls cost three times as much per head as in smaller communities and even then cannot obtain so low a rate of mortality. Similar are the figures, of higher costs and less efficiency, in the control of crime. Even more condemnatory is the fact that big cities are not biologically sound. Their birth-rate is too low and only a continuous flow from more healthy environments can keep them in being. Communities will, of course, still vary in size and conditions. Distributive centres for productive energy must still carry relatively dense human populations. Differences in climate and topography must still regulate the proportions of land devoted to crop, stock, fruit, or forest. There can, fortunately, be no absolute uniformity either in Nature or human nature, but everywhere there can be fruitful living for man, built up on real intimacy with his material. Therefore, provided that the science of forestry is ready to integrate its practice and particularly its research work, fully and efficiently, with the everyday life of the common man, the future may offer abundant opportunities. Also, in order to provide the essential machinery for scientific, comprehensive planning, every possible influence should be brought to bear upon Governments to create boards, on the model of the Tennessee Valley Authority, for large areas which will be as scientifically homogeneous as possible and consequently usually overlapping the existing administrative areas. Such authorities should be brought into being with the minimum delay, so as to be functioning fully when war ends and to be able to employ troops, pending their demobilization, on preparation of chosen sites for new communities, in which demobilized troops would be the majority of settlers. The choice of

such settlements and their planning as integral parts of the comprehensive plans for each region, which will have to be done in many cases through detailed schemes for remodelling existing villages and towns, is a large and onerous, but worthy, task which needs to be taken up at once.

ZANONIA INDICA L. IN EASTERN BENGAL

By S. K. Sen,

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Zanonia indica L. is a large cucurbitaceous climber found in India, Ceylon, Java, Borneo, New Guinea, and Malaya. On the authority of Griffith (1810-45), the *Flora of British India*[1] mentions "Assam and East Bengal" among its Indian localities.

The single sheet of the plant from Bengal in the Herbarium of the Royal Botanic Garden, Sibpur, is labelled "*Zanonia indica* L. Griffith No. 2521, East Bengal". The expression "East Bengal", however, comprises several districts, and some of the districts included in the Dacca division of East Bengal in Griffith's time now form part of the province of Assam; in the absence of precise details, therefore, one cannot be certain as to whether the specimen was collected within the eastern borders of the province of Bengal as now constituted. It appears from a note in the work cited above that Hooker f. and Thomson collected a plant in Chittagong having all the appearance of *Zanonia* but it contained neither flower nor fruit. There is nothing to show that any undoubted specimen of the plant was collected in Bengal after Griffith. It was, evidently, for these reasons that *Zanonia* did not find a place in Prain's *Bengal Plants*; it has also met with a similar fate in Assam, where it has not been included in Kanjilal and Das's Flora of that province.

During the rains of 1934 the writer found this plant growing by the side of the road to Mymensingh, beyond Kaoran bridge and about three miles from Dacca, but it was destroyed by jungle-clearers before it could flower; plants raised from stem-cuttings and maintained for a period of over two years grew vigorously but did not come to flower. Some four years later, in September, 1938, a

flowering specimen of the male plant (plate 31, fig. 1) was discovered growing on a mango tree about half a mile further off on the same road, beyond Kaoran Bazar and not far from Tejgaon railway station in January, 1941, the lower portions of the plant were found to have been cut down and removed, but the severed leafless branches still clinging to the supporting tree were sending aerial roots towards the ground after the manner of *Tinospora* plant[2] subjected to similar treatment. For a cucurbit this was a rather unexpected phenomenon; close by there was a *Tinospora** in a similar state and the greyish lenticellate stems of both looked very much alike; but the presence of tendrils (which do not occur in *Menispermaceae*) or of their stumps by the side of the prominent circular leaf-scars[3] ultimately afforded a sure and ready means of identification in the field and the diagnosis was further confirmed by actually raising new plants in the garden from stem-cuttings.

More plants were found later on at Bandar, 12 miles to the south-east, and at Joydebpur, 20 miles to the north of Dacca; but nowhere in a flowering state. In February, 1942, however, a fine fruiting specimen was discovered growing on an *Albizzia* tree close to Kurmitola railway station, 8 miles to the north of Dacca, the characteristic pendulous cylindric-obconic capsules (plate 31, fig. 2) and oblong-winged seeds (plate 31, fig. 3) completing the chain of evidence needed to fix the identity of the plant. The lower part of the stem had apparently been cut off many years ago, but the plant had succeeded in re-establishing connection with the ground by means of aerial roots, the oldest of which had developed an enormous quantity of corky tissue arranged lengthwise in radiating winglike ridges on the outside (plate 32, fig. 1).

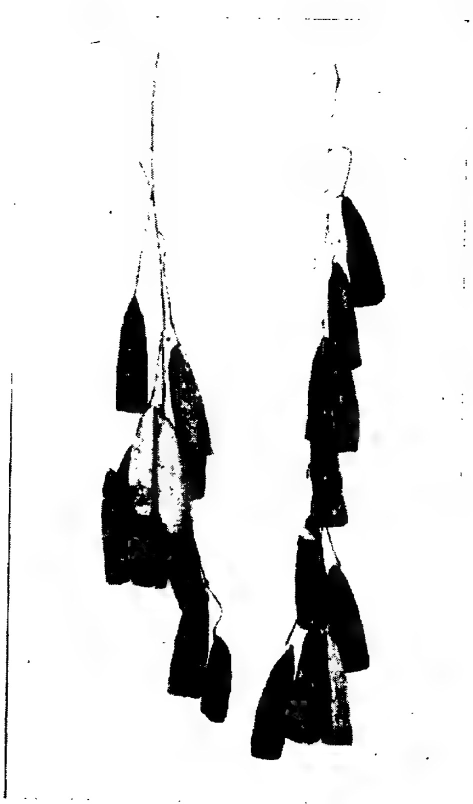
Like *Tinospora,* severed stems of *Zanonia* are amazingly tenacious of life; the aerial roots will persistently grow for months together in their efforts to reach the ground below, producing branches to continue their downward progress should the growing end happen to be damaged or destroyed, while the stems from which they emanate remain leafless all the time. The branches of the plant found cut in January, 1941, were still alive, though leafless, when seen for the last time on the 20th June, 1942; hanging

* *T. malabarica* Miers,

Fig. 1.

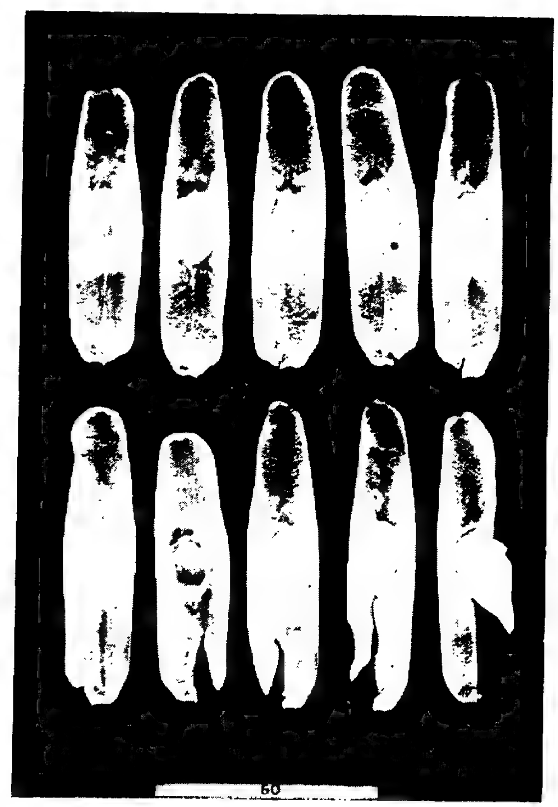
Dried specimen showing male inflorescence (*kaoran*).

Fig. 2.



Fruiting branches (*kurmitola*).

Fig. 3.

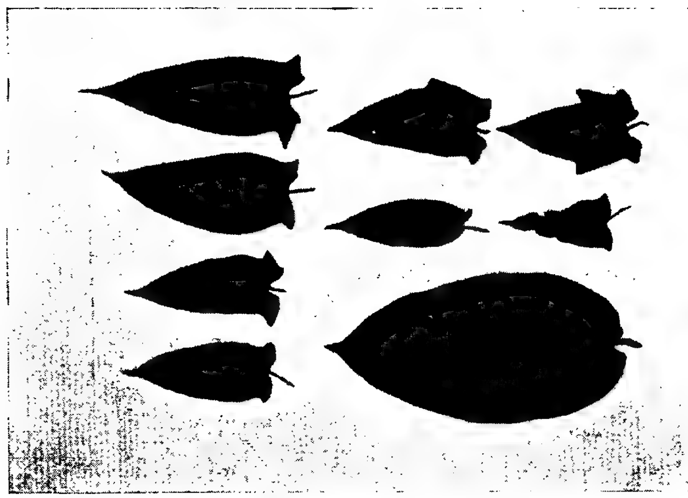


A selection of seeds (*kurmitola*).

Fig. 1.

Corky growth on aerial root (*kurmitola*). All three pieces are sections of the same root; the piece on the extreme left also shows the lower end of the severed stem from which the root arose.

Fig. 2.



Some leaf-shapes.

aerial roots were still there but none had yet succeeded in securing a foothold below on account of interference by wayfarers. A large specimen collected at Bandar possessed aerial roots which had dropped from a height of nearly 14 feet. A piece of stem about 3 feet long and 7/8 inch thick, which had been left standing on a table about the end of February, started sending out an aerial root from the neighbourhood of its lower extremity in about three weeks' time. Stem-cuttings will readily take root if planted or even if simply kept lying on the ground in a shady place.

The tendrils have been variously described as "simple"[1] "simple or bifid"[3], and "forked"[4], but here they have been found to be bifid or forked in every instance. One authority[1] describes the leaves as "glabrous or nearly so" while according to another[3] the stems, tendrils, petioles, and the upper surface of the leaves are glabrous; but in plants growing here in situations exposed to light all these parts have been found to be pubescent at first and to retain their pubescence in varying degrees for a considerable length of time; it has, however, been observed that hair-development is reduced to a minimum in plants growing in the shade, where pubescence is often only faintly discernible in the youngest parts and quickly disappears as the parts grow older.

The shape of the leaves has been described as "ovate rounded or cordate at the base"[1], "ovate-oblong, acute, entire, * *3-nerved from a rounded or slightly cordate base"[3], and "ovate-cordate"[5]; but the examination of a large number of living specimens grown from cuttings as well as seeds shows that, in this part of the country at least, the leaves produced during the earlier stages of growth of the stems (and branches) are heteromorphous, being variously lobed and auricled (plate 32, fig. 2), and that the types mentioned above gradually appear at a later stage.

In the Bombay Presidency the fruit appears to ripen in May[3], but those collected here in February were found to have already matured and all the seeds planted proved to be viable.

The truncate apex of the capsules is provided with three triangular valves meeting at the centre. The mode of dehiscence is peculiar; instead of opening outwards, as one would naturally expect, the valves recede *inwards* and finally rest against the inner wall of the capsule between the shrunken placentas on each side.

The seeds are described as surrounded by a large membranous wing [1] & [3], and are also figured as such [6] & [7], but it appears that the encirclement is not always uniform and complete and that various shapes (plate 31, fig. 3) are assumed in consequence.

Ridle[7] includes *Zanonia* among plants of which the seeds are dispersed by wind and describes how these are released and disseminated; but the seeds float perfectly in water and as the plant occurs not only in dry inland areas but also on the banks of streams (*e.g.* at Bandar), it is quite possible that dispesral can, and to a certain extent does take place through the agency of water.

Like many other members of the family, *Zanonia indica* is used medicinally[8-12] in Ceylon and different parts of India and Gujerati, Hindi, Marathi, Sanskrit, and Sinhalese names are cited in Indian works of reference but its virtues do not seem to be recognized in Bengal. No local name could be found for it in Dacca, where the leafless stems are easily mistaken by the common people for *Tinospora* (*ghunchi-lot*); by a few, however, the capsules are called *bandar-khili* (=monkey's *khili*), apparently on account of the fancied resemblance of the green fruits to the cone-shaped rolls or *khilis* into which betel leaves are made up for chewing.

The age at which the plant begins to flower has yet to be found out; a number of plants grown from both seeds and cuttings are now under observation and it is hoped that it will be possible to clear up the point in a few years' time.

The localities named in this note are all situated in the Dacca district; but it is quite likely that with patient and careful search the plant will also be found in the neighbouring districts of Tippera and Mymensingh as well as in Chittagong.

The writer is grateful to Dr. S. K. Mukerjee, Curator of the Herbarium, Royal Botanic Gardens, Sibpur, for particulars relating to Griffith's Sheet No. 2521 and to Dr. P. Maheshwari for his keen and active interest in the search for the plant and in the plant itself. His acknowledgments are also due to Messrs. Reayat Khan and Balwant Singh for help rendered in various ways. At the instance of Dr. Maheshwari, and under his guidance, Mr. Singh has undertaken an investigation of the anatomy of the plant and

his first paper on the subject entitled "The Anatomy of the Stem, Leaf, and Petiole of *Zanonia indica L.*" will shortly be published elsewhere.

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FLOWERING AND FRUITING OF FOREST TREES OF CEYLON—III.

BY C. H. HOLMES

K. *Myrtaceae.*

21. *Syzygium cumini,* Skeels. Sinhalese: *madan, maha dam.* Tamil: *perun-naval naval.*

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Naula and Puttalam ranges.

As with most dry-zone species the seasons of flowering and fruiting are well defined. Flowering is generally prevalent during July and August though frequently commencing about a month earlier and extending to a month later. Trimen, however, records the period of flowering as from May to August. Ripe fruit is generally available in October/November well in time for the north-east monsoon which provides the principal rains in tracts occupied by this species.

L. *Lythraceae.*

22. *Lagerstroemia speciosa,* Pers. Sinhalese: *muruta.*
Tamil: *pumarathu.*
English: "Pride of India", "Queen of the Forest."

Distribution: Ratnapura, Kurunegala (Polgahawela, Ambepussa, Dodangaslande), Kekirawa, Kegalle, Waga and Avissawella ranges.

For the obvious reason of the extremely showy flowers recorded observations are more numerous on flowering than on the much less conspicuous fruiting. As stated by Trimen the flowering period is definitely April to July generally but flowering may commence as early as in March or even February and extend beyond July to September sporadically. The flowering usually takes place immediately after foliage has been completely renewed. The number of observations recorded on fruiting has been comparatively few but indicate that fruits ripen generally about November/December, dry seed being available up to the end of January.

M. *Sapotaceae.*

23. *Madhuca longifolia,* Macbr. Sinhalese: *mi.*
Tamil: *iluppai.*
Distribution: Tricomalie, Batticaloa, Jaffna, Anuradhapura, Naula, Kurunegala, Ratnapura (Rathkarawa), Haputale (Moneragala) and Puttalam ranges.

The period of flowering is generally May/June though Trimen states flowering is from February to May. Fruiting follows immediately afterwards and has been observed from June to November. Ripe fruit is usually available in August, September and October. Seed collections have been made from September to November but mostly in October.

24. *Manilkara hexandra,* Dubard. Sinhalese: *palu.*
Tamil: *palai.*
Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Naula, Kurunegala (Maho), and Puttalam ranges.

Flowers have been observed as early as in January, sometimes in December, but the height of the flowering season throughout its range of distribution is February/March. This coincides with observations made by Trimen. Fruits are observed soon afterwards and ripe fruits become available and fall in May, June and July. Some late fruit remains available in August but very little and rarely after that to September. Trimen records the species as fruiting in July. Actual seed collections have generally been made almost restricted to the months of May, June and July. Fruiting is usually prolific each year, yet natural regeneration is extremely rare. In part at least this fact may be due to the unseasonable time of fruiting and the inability of the seed to retain its viability for long.

N. *Ebenaceae.*

25. *Diospyros ebenun,* Koenig. Sinhalese: *kaluwara.*
Tamil: *karunkali.*
English: ebony.
Distribution: Trincomalie, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Kurunegala (Pallekele, Maho) and Puttalam ranges.

Flowering begins about March, is most prevalent in March/April and extends sporadically to June/July. Trimen records March as the month of flowering. Ripe fruit appears generally available in September and October. According to Brown, a former conservator of forests, Ceylon, as quoted by Troup (vide *Silviculture of Indian Trees,* Volume II, page 654), this species is said occasionally to seed twice in the year. This, however, has not been observed yet. Though one seed collection is recorded as having been made in May, 1939 (Trincomalie), seed for experimental purposes has mostly been collected in October.

O. *Loganiaceae.*

26. *Strychnos nux-vomica, L.* Sinhalese: *goda-kaduru.* Tamil: *kanchurai.*

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Kurunegala and Puttalam ranges.

Flowering commences about March/April, and continues to August and September. Trimen records flowering as in August. Fruiting as may be expected also covers a rather protracted period and ripe fruit is generally available from October/November to February/March. The fruit available late in a year appears to be from that set very early in that year and early fruit from that set late in the previous year.

P. *Verbenaceae.*

27. *Vitex pinnata, L.* Sinhalese: *milla.* Tamil: *kadda-manakku.*

Distribution: Trincomalie, Batticaloa, Jaffna (Kilinochchi), Vavuniya, Anuradhapura, Kekirawa, Puttalam (and Chilaw), Haputale (Moneragala), Kurunegala, Dandagamuwa, Kegalle, Kandy, Waga, Avissawella and Ratnapura, Elpitiya, Matugama, Galle, and Matara ranges.

This species is found flowering sporadically right throughout each year but is most generally and frequently observed to be in flower from May to October. There is no particular distinction as regards times of flowering in the wet as compared with the dry zone. Trimen records flowering as being from July to October. The profusion of the beautiful Verberna like mauve flowers make flowering very conspicuous whilst the fruits which are small berries are relatively inconspicuous. The young berries are green in colour and only seen easily when they ripen. They are then a purplish black. Though several ranges, *e.g.* Vavuniya, Kilinochchi, Trincomalie and Batticaloa have recorded fruiting practically continuously throughout the year the main period during which ripe fruit is available and falling is undoubtedly September to November. As in the case of flowering so as regards fruiting there does not appear to be any differences in the behaviour of the species in the dry as compared with that in the wet and intermediate zones. Seed collections have most frequently been at the beginning of the year—February, March—and towards the end of the year—chiefly, however, in the months of September to November.

Q. *Myristicaceae.*

28. *Horsfeildia iriya,* Gaertn. Sinhalese: *iriya.*

Distribution: Galle, Matara, Elpitiya, Matugama, Ratnapura, Waga, Kurunegala, Kegalle, Avissawella and Kekirawa ranges.

The flowering of this species appears generally to occur towards the end of the year continuing to the beginning of the next. The principal months of flowering are usually November, December and January with a variation of about a month more or less. Trimen gives January and February as the months of flowering. Ripe fruit appears to become available in time for the following south-west monsoon and is generally found in the months of May, June, July and August, principally in May and June. Reports from a working plans reconnaissance party camping in the Ratnapura district in 1938 appear to indicate ripe fruit available also in October and November! This has not, however, been confirmed by observations from other ranges. Seed collections have been made from April to September but mostly in May.

R. *Lauraceae.*

29. *Alseodaphne semecarpifolia,* Nees. Sinhalese: *wewarana.* Tamil: *yava-ranai, ranai.*

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Matugama (Wirawilla), Kurunegala (Maho) ranges.

Flowering is generally February, March, April though occasionally observed a month earlier to a month later. The fruits ripen and fall usually in June/July. Trimen records August/September and April as the months of flowering but no records of flowering either in August or September have been made by any observer in the 4 years during which statistics on flowering and fruiting have been collected. Seed collections have been made from May to October, mostly in June.

S. *Euphorbiaceae.*

30. *Hemicyclia sepiaria, W. & A.* Sinhalese: *wira.* Tamil: *virai.*

Distribution: Trincomalie, Batticaloa, Jaffna, Vavuniya, Anuradhapura, Kekirawa, Kurunegala (Kala-oya, Maho, Pallekele, etc.), Naula ranges.

This species flowers and fruits abundantly each and every year. Flowering is generally early in the year commencing as early as in January and continuing up to the end of April or thereabouts. The height of the flowering is usually in February/March which are also the months of flowering as given by Trimen. The fruits ripen in June of the same year and continues to fall to July/August.

T. *Urticaceae.*

31. *Artocarpus nobilis,* Thw. Sinhalese: *del, bedi-del.* Tamil: *arsini-pila.* English: The Wild Bread-Fruit.

Distribution: Galle, Matara, Elpitiya, Matugama, Waga, Avissawella, Ratnapura, Kegalle, Dandagamuwa and Kurunegala ranges.

Comparatively few observations have been recorded on flowering, probably due to the fact that the inflorescences are rather inconspicuous and hidden by the large leaves and possibly also on account of the female inflorescences being passed off as young fruits. The observations indicate that the season of flowering is about March/April up to June. Trimen records the species as flowering in June. Information gathered on fruiting has been remarkably uniform both for the different years as well as for different stations. Ripe fruit is generally available from May to August, but mostly from June to August, when seeds carried by monkeys, squirrels, flying foxes, crows, etc., are found falling. All seed collections made for experimental purposes during the past four years have been in the months of May, June and July.

(*Concluded.*)

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FLOWERING AND FRUITING

No.	Species.	Distribution.
A.	**Dilleniaceae.**	
1.	**Dillenia retusa**, Thumb.	Widespread, very common wet and intermediate zones.
2.	**Wormia triquetra**, Roxb.	ditto
B.	**Dipterocarpaceae.**	
3.	**Dipterocarpus zeylanicus**, Thw.	Wet zone.
4.	**Vateria copallifera**, Ritz.	Wet zone.
C.	**Malvaceae.**	
5.	**Gossampinus malabarica**, D.C.	Wet, intermediate and moister dry zone.
D.	**Tiliaceae.**	
6	**Pityranthe verrucosa**, Thw.	Dry zone particularly eastern Province, Trincomalie & Batticaloa dists.
7.	**Berrya cordifolia**, Burret.	Dry and intermediate zones.
E.	**Burseraceae.**	
8.	**Canarium zeylanicum**, Bl.	Wet and intermediate zones.
F.	**Meliaceae.**	
9.	**Melia composita**, Willd.	Wet, intermediate and dry zones.
10.	**Azadirachta indica**, A. Juss.	Dry zone.
11.	**Walsura piscidia**, Roxb.	Dry zone.
12.	**Chloroxylon swietenia**, D.C.	Dry zone.
G.	**Sapindaceae.**	
13.	**Schleichera oleosa**, Merr.	Widespread in low country. Dry and intermediate zones chiefly but also in wet zone.
H.	**Anacardiaceae.**	
14.	**Mangifera zeylanica**, Hk. f.	Wet, intermediate and dry zones.
I.	**Leguminoseae.**	
	(a) ***Caesalpinieae.***	
15.	**Cassia fistula**, L.	Dry and intermediate zones.
16.	**Cassia marginata**, Roxb.	Dry zone.
17.	**Cassia siamea**, Lam.	Dry and intermediate zones.
18.	**Tamarindus indica**, L.	Dry zone.
	(b) **Mimoseae.**	
19.	**Acacia leucophloea**, Willd.	Dry zone.
J.	**Combretaceae.**	
20.	**Terminalia Arjuna**, W. & A.	Dry zone also in intermediate and wet zones.
K.	**Myrtaceae.**	
21.	**Syzygium cumini**, Skeels.	Dry zone.
L.	**Lythraceae.**	
22.	**Lagerstroemia speciosa**, Roxb.	Wet zone, low country.
M.	**Sapotaceae.**	
23.	**Madhuca longifolia**, Macbr.	Dry zone also cultivated in intermediate zone.
24.	**Manilkara hexandra**, Dubard.	Dry zone.
N.	**Ebenaceae.**	
25.	**Diospyros ebenum**, Koenig.	Dry zone.
O.	**Loganiaceae.**	
26.	**Strychnos nux-vomica**, L.	Dry zone.
P.	**Verbenaceae.**	
27.	**Vitex pinnata**, L.	Dry, intermediate and wet zones.
Q.	**Myristicaceae.**	
28.	**Horsfieldia iriya**, Gaertn.	Low-country, wet and intermediate zones.
R.	**Lauraceae.**	
29.	**Alseodaphne semecarpifolia**, Nees.	Dry zone.
S.	**Euphorbiaceae.**	
30.	**Hemicyclia sepiaria**, W. & A.	Dry zone.
T.	**Urticaceae.**	
31.	**Artocarpus nobilis**, Thw.	Wet and intermediate zones.

OF CEYLON TREES

Months of Flowering.	Months of Ripe Fruit.	Remarks.
Whole year round, mostly at beginning and end of the year.	Whole year round, mostly at beginning and end of the year.	Fruits collected in December, January, February & March.
Whole year round, particularly September to December/January.	Whole year round, particularly September to December/January.	—
November/December.	March/April.	Fruits collected March/April.
March/April.	September/November.	Fruits collected September, October, November.
December, January and February.	March/April.	Seed collected generally March/April.
October/January.	March/April.	—
January, February and May, June and July.	August, September, October and November.	Seed collected principally September/October also June/July.
February/March.	January/February, September/December.	Fruits collected principally in December/January/February and June/July.
March/April.	December/January/February/March.	—
April/May/June.	August/September/October.	Ripe fruit collected generally September/October.
February/March.	June/July.	—
April/May.	July/August to September/October.	Seed collected mostly in July/August and also in September/October.
March/April.	June/July.	Seed collected mostly June/July.
January/March.	May/June/July.	Seed collected May/June chiefly May.
June-July.	May/June/July.	Seed collected mostly May/June.
August to November.	May/June.	
March-June-August-November.	About May and October to November.	Seeds collected principally in May-July, also in December.
July/**August**/September.	May/June.	Seed collected April-June.
July/**August**/September.	April/May.	Seed collected March & May.
April/May.	September/October/November.	Seed collected in September.
July/August.	October/November.	—
April/July.	November/December.	—
May/June.	August/September/October.	Seed collected September, October and November.
February/March.	May/June/July.	Seed collected May/June/July.
March/April.	September/October.	Seed collected mostly in October.
March/April to August/September.	October/November to February/March.	—
May to October.	September/October/November.	Seed collected mostly in September/October/November.
November / December/ January.	May/June/July.	Seed collected from March to August, mostly in May.
February/March/April.	June/July.	Seed collected mostly in June.
February/March.	June/July.	—
March/April to June.	June/July/August.	Seed collected in May/June/July.

TIMBER PRICE LIST, SEPTEMBER-OCTOBER, 1942
(INDIAN STATES)
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Cochin ..	Logs ..	Re. 0-9-3 to 0-11-0 per c.ft.
,,	,,	Travancore .	Logs ..	Re. 0-11-6 per c.ft.
Benteak ..	*Lagerstrœmia lanceolata*	Cochin ..	Logs ..	Re. 0-9-10 to 1-0-4 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	
,,	,,	Travancore ..	Logs ..	Rs. 1-14-3 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Barwani ..	Logs ..	
,, ..	,, ..	Cochin ..	Logs ..	Rs. 1-1-6 to 1-2-2 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Holkar ..	Beams 14′ × 18″	
,, ..	,, ..	Hyderabad ..	Logs ..	Re. 0-12-0 to 2-0-0 per c.ft.
,, ..	,, ..	Mysore ..	Logs ..	Rs. 2-3-6 to 3-4-6 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-10-9 per c.ft.
Deodar ..	*Cedrus deodara* ..	Patiala ..	Sleepers 10′ × 10″ × 5″	
Dhupa ..	*Vateria indica* ..	Cochin ..	Logs ..	Re. 0-12-11 to 2-0-0 per c.ft.
Gamari ..	*Gmelina arborea* ..	Tripura ..	Logs ..	Rs. 1-0-0 to 1-12-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Cochin ..	Logs ..	Re. 1-9-11 per c.ft.
,, ..	,, ..	Tripura ..	Logs ..	Rs. 1-0-0 to 1-8-0 per c.ft.
Haldu ..	*Adina cordifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Banswara ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	
,, ..	,, ..	Bhopal ..	Logs ..	
,, ..	,, ..	Cochin ..	Logs ..	
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-5-3 per c.ft.
Hopea ..	*Hopea parviflora* ..	Cochin ..	Logs ..	Rs. 1-8-7 per c.ft.
,, ..	,, ..	Travancore ..	Logs ..	Rs. 2-6-7 per c.ft.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bansda ..	Logs ..	
,, ..	,, ..	Barwani ..	Logs ..	
,, ..	,, ..	Cochin ..	Logs ..	Rs. 1-9-10 to 3-14-9 per c.ft.
,, ..	,, ..	Dhar ..	Logs ..	
,, ..	,, ..	Kishengarh	Logs ..	
,, ..	,, ..	Mysore ..	Logs ..	Rs. 2-0-6 to 2-14-0 per c.ft.
,, ..	,, ..	Patna ..	Logs ..	
,, ..	,, ..	Travancore ..	Logs ..	Rs. 1-11-9 to 2-8-3 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Irul ..	*Xylia xylocarpa* ..	Cochin ..	Logs ..	Re. 0-10-9 to 1-8-7 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-6-0 per c.ft.
Kindal ..	*Terminalia paniculata* ..	Cochin ..	Logs ..	Re. 0-10-6 to 1-3-8 per c.ft.
" ..	" ..	Mysore ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	Rs. 1-11-6 per c.ft.
Laurel ..	*Terminalia tomentosa* ..	Bansda ..	Logs & squares	
" ..	" ..	Barwani ..	Logs ..	
" ..	" ..	Bhopal ..	Logs ..	Re. 0-12-0 to 1-8-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Re. 0-11-1 to 1-6-2 per c.ft.
" ..	" ..	Holkar ..	Sawn material	
" ..	" ..	Hyderabad ..	Logs ..	Re. 0-6-0 to 0-14-0 per c.ft.
" ..	" ..	Mysore ..	Logs ..	Rs. 1-11-0 per c.ft.
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Travancore ..	Logs ..	Rs. 2-2-2 per c.ft.
Mesua ..	*Mesua ferrea* ..	Cochin ..	..	
" ..	" ..	Tripura ..	Logs ..	
Sal ..	*Shorea robusta* ..	Cooch Behar	Logs & scantlings	
" ..	" ..	Patna ..	Logs ..	
" ..	" ..	Tripura ..	Logs ..	Re. 1-8-0 to 2-4-0 per c.ft.
Sandan ..	*Ougeinia dalbergioides* ..	Bansda ..	Logs ..	
" ..	" ..	Patna ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Banswara ..	..	
" ..	" ..	Cochin ..	Logs ..	Re. 0-9-0 to 0-11-0 per c.ft.
" ..	" ..	Cooch Behar	Logs & scantlings	
"	" ..	Rampur ..	Planks 6′ × 1′ × 1¼″ ..	
" ..	" ..	Travancore ..	Logs ..	Re. 0-11-6 per c.ft.
" ..	" ..	Tripura ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
Sissoo ..	*Dalbergia sissoo* ..	Banswara ..	..	
" ..	" ..	Cooch Behar	Logs & scantlings	
" ..	" ..	Hyderabad ..	Logs ..	
" ..	" ..	Rampur ..	Planks 6′ × 1′ × 1¼″ ..	
Teak ..	*Tectona grandis* ..	Bansda ..	Logs ..	
" ..	" ..	Banswara ..	Logs ..	
" ..	" ..	Barwani ..	Logs ..	
" ..	" ..	Bhopal ..	Logs ..	Rs. 1-8-0 to 2-4-0 per c.ft.
" ..	" ..	Cochin ..	Logs ..	Rs. 2-4-11 to 2-11-1 per c.ft
" ..	" ..	Holkar ..	Sawn material	
" ..	" ..	Mysore ..	Logs ..	Rs. 4-3-6 to 5-7-0 per c.ft.
" ..	" ..	Travancore ..	Logs ..	Rs. 1-11-2 to 4-14-8 per c.ft.

EXTRACTS

PYRETHRUM—ITS UTILITY AND POSSIBILITIES

By D. P. Majumdar, B.Sc (Ag.)

Pyrethrum is a perennial drug plant and it belongs to the family of Compositæ. The insecticidal property of this plant is known as the "pyrethrin," which is obtained mainly from pyrethrum flowers. The flower which is the chief harvesting material, contains in the stamens and pistils, the insecticidal agent in its most concentrated form. So a proper growth of the flower heads is essential. The highest total pyrethrin content recorded in Kenya is 1.36 per cent. and even up to 1.4 per cent. And here in India the highest content recorded is 1.13 per cent. from Assam.

Pyrethrum is of two species—one is known as Persian with red or rose pink flowers, and the other is Dalmatian (Yugoslavia) with white flowers. The botanical name of the former is *Chrysanthemum roseum* and that of the latter is *Chrysanthemum cinariæ folium* which, having gained popularity owing to its more effectiveness, is being cultivated widely. The plant is ordinarily 18 to 20 inches in height.

Origin.

The original home of the plant seems to be in Persia. During the early part of the 19th century Europe used to import both the plant itself and flower powder from Persian fields and markets to meet a widespread demand for an effective vermifuge. Later on in about 1850—60, a new species of the plant was produced in Dalmatia which gradually proved to be of superior quality to the Persian

stuff. Long after this period the plant found its way to other places like Japan, Kenya, etc.

Necessity, Uses and Products.

NECESSITY.—In India it is an undisputed fact that every year a fairly large portion of different crops is being destroyed in the fields, due to insect attacks, and also considerable damage in store-houses is often reported. Thus the total production happens to be much less than what is expected in the beginning. Besides, it is often seen that these insects not only create annoyance to cattle, horses, poultry, etc., and even to human beings, but also create havoc at times as carriers of germs of various diseases. It is therefore of imperative necessity that pyrethrum being an insect-exterminator should be grown in abundance in India in order to remove these pests and save the land from their various depredations.

It is observed that the use of pyrethrum is rapidly increasing in India and that almost the entire supply of the drug is being obtained from Japan. But as Japan is now engaged in a world-wide war the supply of pyrethrum from that country as well as from other foreign lands will be curtailed to a considerable extent. This fact also indicates a greater necessity for growing this crop in India on a very large scale without any loss of time.

USES.—The uses in brief are as follows:—(1) for anti-malarial work, (2) for extermination of flies and insects on crops, (3) for destroying fleas and lice from cattle, horses and poultry, and (4) for the protection of crops against blight and other diseases.

Products.—An authoritative article (*The Pyrethrum Industry of Japan* by the British Vice-Council at Seol, Japan) enumerates a great range of products which can be made chiefly from pyrethrum flowers and to some extent from the leaves and stalks. A brief description of the products may be interesting here. There are three basic products. The first is Flower powder—under this category come the articles known to the trade as "Fly powder," "Insect powder" and "Bug powder"—. These are used to kill the insects of fruit trees, vegetables, cattle and poultry. The second is leaf and stalk powder—as it was found to possess certain insecticidal properties, this powder is either made into mosquito sticks for use in dwellings or mixed with the flower powder in order to be used as a

grub killer. This is widely used for purposes of sanitation in Japan. The third is Liquid Extract Mixture—this extract in different degrees of dilution is used for the extermination of bird lice and vermin.

Again, from the three basic products, there can be obtained no less than six derivative products, namely, (*i*) Pyrethrum Carbon Mixture, (*ii*) Pyrethrum Lixivium: both are used to exterminate the larvæ of moths and butterflies; (*iii*) Pyrethrum Petroleum Emulsion—this is chiefly used to protect the crops against blight; (*iv*) Pyrethrum Lixivium Petroleum—this is known as the exterminator of dust and dirt carriers; (*v*) Tincture of Pyrethrum—this is mainly used to eradicate the insects which attack cherry, peach and mulberry trees, and to exterminate lice and fleas from cattle and horses; (*vi*) Pyrethrum Powder—its effect is the same as ordinary "Insect powder."

PYRETHRUM PRODUCTION

U. S. A. has always been the prominent importer of Japan's export of pyrethrum; *e.g.*, in 1928 about 90 per cent. of Japan's exports were taken by U. S. A. and the rest was imported by the United Kingdom, France, Germany, Australia, India and Canada combined. The area under cultivation in 1928 in Japan was 26,824 acres, while in 1937 it increased to 60,160 acres and the yield in the same year was 9,912 tons. The production at present is about 10,071,100 lbs. per year, which is valued at 2 crores of rupees nearly. In European countries also the extent of cultivation of this crop is not negligible. In Kenya where the cultivation is a recent one, the area and the yield are both increasing every year. The area planted in 1935-36 was 3,469 acres and the yield was about 582 tons, while in 1936-37 the area went up to 4,624 acres and the yield was about 1,041 tons. Export figure of dried flowers from Kenya has also increased from 32,268 lbs. in 1933-34 to 21,85,792 lbs. in 1936-37. As regards India, the area sown is not known as all the work is almost experimental, except in Kashmir where about 200 acres are under cultivation and the expectation is to increase the area to 1,000 acres and to produce 300,000 lbs. of dried flowers within the next two years. The provinces in India are also on the look-out to expand the areas and to utilise their experimental knowledge in growing it on a large scale in the field.

Cultivation of Pyrethrum in India

Pyrethrum cultivation is still in its infancy in India. Of course, trials and experiments conducted through proper channels will no doubt lead towards the success of its cultivation, as had been the case in other countries where it has now occupied an important position in crop production.

Some efforts were made to introduce the crop in this country during the last few years. In the year 1937 the Imperial Council of Agricultural Research seriously considered the matter of introduction of pyrethrum into India in right earnest, and observed that there were possibilities of growing this crop profitably in India and that the matter should be further examined by proper experiments in suitable places. With that end in view the Imperial Council of Agricultural Research got some seeds through the India Office, from the Director, Plant Pathological Laboratory, Harpenden, England, in the same year, and distributed them to different provinces and States. Again, in the beginning of 1940 some seeds were obtained from Dalmatia.

For a number of years, experiments were carried out in different Agricultural Departments with the result that in some places its cultivation had been a failure and in some others it had been hopeful and promising. This crop has fared well and proved to be successful at Murree, Kulu and Palampur in the Punjab, Shillong in Assam, and in Kashmir. Promising results were also obtained from certain parts of Nilgiris and N.W. F. P. But Bombay, U.P., Sind and Mysore are declared as unsuitable for its cultivation.

Analyses for the pyrethrum content of the flower samples obtained from different places show the following results:—Samples from Kashmir and Palampur in the Punjab possess a pyrethrum content of .95 per cent. and .96 per cent. respectively. The pyrethrum content of N. W. F. P. samples ranges from .61 to 1.11 per cent., whereas the Assam samples contain 1.13 per cent. Indian samples are however still below the level of Kenya samples.

Assam, as the product of her soil is found to contain higher percentage of pyrethrum, seems to be eminently suitable for the cultivation of pyrethrum; and as such there is a possibility of her being able to compete successfully even with Japan and Kenya.

Experiments have shown that pyrethrum in India thrives well approximately in an altitude of 4,000 feet and above, and that it has been observed with certainty that it will grow best in a comparatively dry climate with well-drained light soil. Yields of about 400 lbs. of dried flowers may be obtained per acre, but it may not be the case everywhere. Cultivation methods naturally differ from place to place but the following may be taken as a rough outline of the general procedure.

Cultivation Procedure

Soil Tilth.—Land is to be prepared in such a way as to obtain a fine tilth of the soil by repeated ploughings and interculture. Special care must be taken to eradicate weeds completely from the field as otherwise they will destroy the tender seedlings.

Time of Sowing.—There are two sowing seasons, one in the Spring (March-April) and the other in Autumn (September-October). In Kashmir seeds sown in autumn gave the highest germination, whereas April sowing gave a fair result in that respect. In the Punjab sowing is done in March-April. In Assam the highest percentage of germination was obtained from March sowing. The seeds germinate within 10—15 days, but as a matter of course germination depends much on the freshness and viability.

Spacing and Seed Rate.—The most common spacing practised is 18″ x 18″ which proved quite satisfactory. With this spacing about 20,000 plants may grow per acre. As regards seed-rate approximately 1 lb. of seeds per acre will be found adequate.

Method of Sowing.—Before sowing, the seeds are thoroughly soaked in water; they are then wrapped in cloths or sacks and buried in damp sand for 4 or 5 days, after which they are mixed with dry sand and evenly broadcast on a slightly raised seed-bed. As regards the preparation of bed, Kashmir experiments suggest: "Before the seed is sown, the seed-beds should be prepared a season ahead, so that during this interval it could be made free of weeds by repeated interculture."

Transplanting.—After the land has been prepared well, the seedlings from the nursery are transplanted best on ridges. By 6 to 7 weeks' growth the seedlings become 3″ to 4″ tall and they are then ready for transplanting. Seedlings from Spring sowing may be

transplanted from mid-April to July, whereas Autumn transplantation may be done best from mid-October to end-November provided irrigation water is available. Failing that the seedlings may be allowed to over-winter in the nursery bed and then transplanted in early Spring.

Proper selection of transplanting times is very important, for too early transplantation produces poor flowers, while in too late transplantation cold will kill the seedlings before they are able to establish themselves firmly in the soil.

Irrigation.—Water may be applied, if necessary, depending on the soil and climatic conditions. The crop grown in Spring may utilise the rains. Still, if irrigation is considered necessary at all, only one watering may be given provided the Spring is dry. On the other hand more than one irrigation will be needed for autumn planting. Of course all these will depend on the condition of the locality where the crop is grown. Sufficient care must be taken in order to avoid water-logging even for a day or two due to irrigation or rain water. The wet condition of the land will invariably damage the crop.

Drainage.—As inefficient drainage encourages water-logging of the soil, plants in such portions of the field usually die of root-rot. Therefore a slight gradient of the soil is preferable to facilitate drainage. The chief reason why heavy soils do not favour growth is poor drainage.

Manures.—Observations in this respect are incomplete as yet It has been however found that excessive application of nitrogenous manures gives a luxuriant growth of vegetative parts, but results in an absence of flowers. In less fertile and sloping soil considerable manuring is beneficial, as such land is subject to being washed away more by the rain water than a level and fertile land. Well-rotten cow dung may be applied with safety. But care should be taken that manuring does not affect flower-formation and the pyrethrin content adversely.

Propagation.—This may be done both by seeds and rooted suckers or splits of the parent plants. For rapid multiplication of the plantation the latter method is advantageous as one can increase by this method the area of his field in a comparatively short time.

Harvesting or picking.—The harvesting or picking is a very delicate operation as on it depends the major part of the success of cultivation. Failure to choose the right time of picking lessens the pyrethrin content and at the same time reduces the yield. The picking season differs in different places, but the operation may be undertaken when the flower-heads are 70 per cent. open.

In Kashmir the harvesting season of autumn plantation starts from the beginning of June. In the Punjab pyrethrum flowers about one year after the time of transplanting and therefrom the harvesting starts as soon as the flowers are sufficiently open.

The next important process after picking is the drying of flowers which consists in removing the moisture from the flowers and thereby effecting about 75 per cent. loss in weight. The flowers are dried in the sun and marketed in this form.—*The Allahabad Farmer,* Vol. XVI, No. 2, dated March 1942.

A PLAN TO HELP STABILIZE RURAL ECONOMY BY THE WISE USE OF FOREST RESOURCES

By Ellery Foster

Bureau of Agricultural Economics

Two of the discussions on today's program are concerned chiefly with forests as a source of materials for military defense, but the topic for this third discussion provides an opportunity to consider forests in their more intimate and direct relation to people who reside and strive to make a living in rural America.

In discussing this subject we might have had someone who has actually helped to stabilize a particular rural community through forest management and who has been studying one or a few communities close-up, as with a microscope. It could have been someone like Forest Supervisor Knutson of the Chippewa National Forest in Minnesota, who has worked out and put into effect, in cooperation with the local people, a plan for closely relating forest management to the needs of each rural community in the forest. Or we might have had, as discussion leader, any one of many other foresters to tell how they have related forest management to the

welfare and stability of some actual community or group of communities.

Instead of an expert on one community, you have a generalist who has been looking as with a telescope at a good many communities. Wide-range study means knowing less and less about more and more communities, and tends to preclude learning more and more about any one community. I like to think, however, that 23 years of living in rural communities have provided a reasonably practical and intimate background of understanding for such long-range study.

A Place for Theory

Such study has its place. It helps in developing a common understanding of common problems, and of ways to meet them. So let us discuss some wide-range concepts and theories, of wise resource use, of stable rural economy, and of planning. Let us consider principles or axioms that may be useful in our continued efforts, as foresters, to help stabilize rural economy by wise use of forests. Let us take time to consider what might be done on the basis of such principles and in light of what we know about the present use of forests of New England and of the whole United States.

I want to make clear that what I am going to say is in the class of "private opinion." In other words, I am here to say what I think as a citizen of one of the few countries where men can still say what they think, and where truth can still freely seek its only final test: acceptance or rejection in the market place of ideas.

What Does "Wise Use" Mean?

First about "wise use." Specifically, what do we mean by "wise use?" For one thing, a great mass of good technical knowledge of forestry exists which is not being applied in the management of most of our forest lands. These scientific resources that are the chief contribution and responsibility of foresters, include well-developed methods of fire protection, feasible insect and disease control, silviculture, sustained-yield, coordinated multiple forest use, and efficient logging, manufacture, and utilization. We could talk all day and all night on these subjects.

One principle which might cover this whole field is that as rapidly as technical forestry knowledge is developed it should be applied to all of the forestry situations to which it is applicable. Generally, the application of this knowledge would have a stabilizing and otherwise beneficial effect on rural economy. Its application requires, however, the acceptance of responsibility by all agencies, individuals and groups that control or influence the use of forests and forest industries. This means, very definitely, that forestry responsibility cannot be centred in a few functional agencies. Rather, it must extend all through our institutions, including private forest and mill owners, logging concerns, and credit agencies as well as government forestry agencies.

Fully "wise use" of forests for maximum community stability requires planning in the broader field of relationships between the resource and the people. This field is a joint responsibility of the whole community, including the forester. We could talk as long or longer on this topic than on the more technical subject. But, our time is limited, so let us merely consider a few principles and a few specific New England situations to which some of them may apply.

First, it should be decided which of the lands in the community area are to be used for forestry. Then, timber-working circles should be planned on a definite community basis in order to provide regular and dependable jobs and income for the community. Forestry activities need be integrated with the other economic activities of the community if maximum stability and benefit is to result. For example, work programs to restore forest resources—to pay our debt to the forests—should be planned to fit in with the employment needs of forest community people.

Forests should be used to provide adequate houses for forest community families. Of all economic anomalies, is any more inexcusable than poor housing right alongside forests that could be used to build good houses?

Should not all forests be developed appropriately for recreation, particularly where population is heavy? There are too many "no tresspass" signs, too many forests with no facilities for picnicking and play.

Generally speaking, forests should not be locked up in a single use. Rather, they should be managed for multiple use. For

example, in New England, planning should—and to some extent does—provide for timber harvesting on recreation holdings of "summer people" and others, where mature and overcrowded trees formerly went to waste.

Timberlands should not continue to be operated with transient logging camps, if they can economically be made to support permanent communities with homes and family life. Should not some of the big forest areas of Maine be studied with this in mind?

The fiscal organization of the forest resource and of the forest industry must be such that the local community gets a full return; excessive amounts of earnings should not be drained off continually to distant financial centres, at the expense of the forest community. To this end, it is desirable either that the forest and the forest industries be locally owned, as, for example, New England's system of community forests, or in the case of state and federal forests, that a full share of the revenue remain in or be returned to the community.

Wise use of forests requires general adjustment of the forest industries to the market and to the forest, as well as adjustment of operations to the needs of the forest community. In this field, it seems to me we might borrow from our experience with some of the other resources in helping to achieve a better adjustment of our forest economy.

We might well give some thought, I believe, to a timber adjustment program, patterned after the agricultural adjustment and ever-normal food supply program. The objectives would be (1) to adjust timber cutting to the market, to the productivity of the forest lands and to the economic life of forest communities; (2) to distribute timber surpluses into useful channels; and (3) to build up depleted forests, through improved fire protection, regulating cutting, timber stand improvement and tree planting work.

Five Principles of "Wise Use"

We have considered numerous principles of "wise use," which, in summarizing our discussion thus far, may be grouped under five broad principles:

(1) Technical forestry knowledge should be applied wherever appropriate, as rapidly as the knowledge is developed;

(2) To that end, forestry should be all through our resource managing structure and not segregated in a few specialized agencies;

(3) Wise use for stability of rural economy requires that forestry and forest industry management must be *related* in a positive way to the needs of the community through planning;

(4) Forest industries must be adjusted to the forest resources and to the market; and

(5) To this end, a timber adjustment and ever-normal timber supply program might be devised along the lines of the agricultural adjustment and ever-normal food supply program.

THE CHANGING RURAL ECONOMY

Next, let us consider what we mean by "stabilize." We cannot interpret a stable economy as being synonymous with a static one. Rural economy is changing with the impact of automobile, tractor, and electricity, which have not yet had time to work out their full effect on agriculture and on rural life.

Another significant factor is that, in the main, our rural communities "jest growed" like Topsy, in a day when we believed more naively than now that uncoordinated individual planning would automatically produce the best kind of economy.

Rural communities of the future probably will be changed by the twin influences of mechanization and of a more deliberate and comprehensive community planning. The forester will need to adjust his efforts with forest resources to fit this changing and evolving form of the rural community. If he has vision he will desire that the forest plans be of aid in bringing about the broader changes in rural economy which are found to be desirable. He will not be content with merely stabilizing conditions which already exist and which may not be entirely satisfactory.

As a general thing, I wonder if we cannot anticipate a more decentralized urban economy spreading out into the country and merging with a rural economy which, in turn, may tend to become somewhat more centralized, as isolated locations and submarginal farms are vacated. To the extent that this occurs we will have a "urban" rather than a rural economy to deal with, an economy which we can hope will combine the best features of both rural and

urban life and lessen the disadvantages of each. This type of development, involving spacious but not isolated living, seems particularly applicable to forest communities where less traditional or folk-lore reason exists for forest workers to live far apart "on the land" than is found among full-time farmers.

As a general principle we can say that we want to manage forest resources in a way that will contribute most fully to developing and maintaining the best possible kind of rural economy, as decided upon in community planning. This, obviously, means working with community planning groups.

If the forester does not coordinate his efforts with the broader objectives of community planning, he may find himself working at cross-purposes with other programs and adjustments. For example, he might be striving to set families up on individual "forest farms" and find that the community plans called for a closer type of settlement in villages or towns where savings could be made in the costs of utilities and transportation and where social advantages could be gained. Or the reverse might be true. He might be planning for compact communities and find that the people preferred to live on individual forest farms.

Our National Debt to Forest Communities

Another principle is concerned with the social and economic relations between forest communities and our industrial communities. For generations the industrial centers have been piling up a debt to forest communities. About half of our rural families live in what are essentially forest regions. They are, by and large, the families which have the most children. In fact, they are the chief group which offsets the deficient birth-rate of our cities; yet, they are the poorer half of our farm families, living where forest resources have been impoverished and exploited and where the land is not well-suited for commercial farming. They are the half of our farmers who get only a tenth or so of our cash farm income.

Our cities depend upon these communities for a stream of migration, a swollen stream in boom times, a thinner stream in "hard times" but always a stream of youth going from these "incubator regions" to the industrial centers. Our nation owes a debt

to the forest region communities, for growing all this human material, and it owes also a debt to itself to help these communities turn out youths who are well prepared for the complexities of modern life. National stability requires that this debt be paid. A program that would give the people useful work in building back the depleted forests would be a very practical way of helping to pay it. Such a program would have the special advantage of helping to get the forest communities back on their own feet and off relief. It would help to stabilize and improve rural economy. We have scarcely begun on such a program, and such beginnings as have been made are only in a few selected communities as where national, state and community forests and intensive farm-forestry and forest-farming projects have been established.

DEPENDENCE ON GENERAL STABILITY

We need also to consider that a stable rural economy depends in large part on a stable general economy, with a steady production and distribution of all kinds of goods and services between town and country and throughout the economy and with reasonable harmony of purposes among the people. Many of the obstacles to forestry arise from our general instability. For example, periods of good markets and boom prices often lead to destructive exploiting of forests, and may be followed by periods of poor markets and low prices which lead to neglect of resources, as with farm woodlands. Another example is farm tenancy. A tenant farmer is hard to interest in forestry. A maladjusted and unstable economy in which many people have a very low standard of living, including poor housing, is doubtless a major reason for unsatisfactory markets for timber.

Unless these basic problems of stability are realistically faced, and solved, we cannot expect to succeed in achieving a full and wise use of forests. Their solution involves the broadest questions of public policy and would probably require fundamental reforms affecting the control and use of all basic resources, including factories and distributive facilities as well as natural resources.

For a number of years now, we have had a policy of public borrowing, spending and investing to help meet the more crucial social needs which result from our basic maladjustments. The

"stop-gap" characteristic of this policy implies that the "normal" condition is one of high economic activity, during which such spending will not be needed. The realistic view, however, does not support such optimism. We have just passed through a whole decade of the "abnormal" conditions during which heavy public spending has been necessary. To-day, we are in a period of heavy spending for defense. Almost everyone looks forward to post-war depression rather than prosperity. If that occurs, we will move out of the heavy war-spending period into a period of heavy demand for unemployment relief and similar government spending.

In the long run, the demand for heavy government spending will be impossible to reconcile with the demand for government economy. The two are in direct contradiction. We have no assurance of "normalcy" periods during which accumulated defense and depression debts could be paid off. I believe most of us feel that the borrowing and spending policy is only a temporary palliative that does not correct the basic ills. The question is what should the long-time policy be.

This is a major problem confronting our whole society. Should the forester who sees its relation to wise use of forests and to the security and well-being of everyone, including himself, sit back and wait for someone else to solve it? Obviously, if it is to be solved in a democratic way, there will have to be a plan which is acceptable to a majority and which deals justly with all groups and individuals. I have my own ideas as to what a plan for general stability might include, but even if time limits did not prevent, it would probably be inappropriate to discuss them here. But should not discussions be organized for the purpose of evolving a plan in this broad field?

Four Principles Connected with "Stabilize"

In considering the term "stabilize" four principles have been considered: (1) Forestry efforts should be harmonized with a changing and evolving form of rural economy; (2) Forests should be used to help develop and maintain the best possible kind of stable rural economy; (3) A program to rebuild depleted forests would help stabilize rural economy and could help pay our debt to forest communities; (4) Wise forest use depends in large part upon a more

stable general economy and we all need to help plan for such an economy.

ABOUT PLANNING

And now, about planning especially as it applies to forests and rural economy; planning is an old word that has had a changing significance through medieval and modern history. Time was when the state did much planning, through kings and nobility, who planned the use of resources and of labor so as to glorify the rulers and support them in luxurious splendor. Then came democracy and laissez faire. According to the laissez faire theory, it was not necessary for the state to plan, except for a police force and a few minor things. The original theory was that every individual should do his be t in planning for himself, and it would all add up, like magic, to the greatest good for everybody. Almost ever since this theory was adopted, the world has been gradually modifying it, and to some extent abandoning it.

Without going into the specific ways in which the laissez faire concept has been modified, or the extent to which it has been abandoned, it can be recognized that considerable over-all planning needs to be done in addition to the planning which each individual should do for himself.

PLANNING BY WHOM, FOR WHOM?

Now that democracy and laissez faire have evolved until the need is recognized for a good deal of over-all planning, we have the question by whom and for whom should over-all plans be made. Some would leave such planning largely to those who have been successful in advancing themselves to ownership or control over huge blocks of resources. Others would have the planning done by scientists, for the people. Still others would have plans made by and for the state; either officials or a popular majority would decide what they felt was good for the state or for society, and would go ahead without regard for individual or minority rights. But the ideals of democracy and of individual liberty require not only that the plans be developed by and for the people, but that individual and minority rights be protected in making and carrying out the plans.

It is a large part of a dilemma of our times that many people distrust or doubt the feasibility of not only the first three schemes—which are more or less autocratic—but also the fourth scheme, the democratic one (with a small d).

We in agriculture have been getting some experience with democracy in planning, and we are now reaching the point where at least one basic principle regarding it can be formulated. We feel that planning should be done by representative people, democratically selected, together with competent scientists and technicians from all the pertinent subject-matter fields who will furnish the necessary scientific knowledge. There should be full discussion, and even with highly technical subjects, the final decision for action must rest with the people. This principle reaffirms Justice Holmes' statement, already mentioned, that the only final test of truth is the ability of an idea to gain acceptance in the market place of ideas. Even more important, it squares with the fact that the wearer of the shoe can best tell where that shoe pinches. It is recognized that the plans must in no way violate the rights which people agree by constitutional law to guarantee to all individuals.

"First Things . . . ."

A third planning principle, which can be accepted as axiomatic, is that we should plan for "first things first" but always with the long-range view.

While this thought of "first things first" is fresh in our minds, we can tie in our theorizing with the practical and immediate forest situation. What is the logical "first thing" or next thing that should be done to help stabilize rural economy by wise use of forests? Mr. Trayer has told us of the advances that have been made in adapting forest resources to defense uses. Mr. Behre has given us a picture of forest resources that are available for defense. Timber is going into defense uses at a great rate.

To log and manufacture the timber needed for defense is, of course, the immediate big job in forestry.

At the same time there is another job which it seems to me should and could do. As foresters, we all believe in the principle that forests where logging is done should be left in the best possible condition for future production. Our forest account has already

been overdrawn and wasted to the extent that it is less than half of what it should be under reasonably good management. And now we are making further inroads for defense.

PREVENT NEEDLESS WASTE

Foresters are among the first to admit that over-cutting of forests is justified in an emergency, but they also insist that we go into it with our eyes open and that there will be no unnecessary waste. Generally, people seem to have their eyes open fairly well to the over-cutting. They know, in general, what is happening to the forests, but apparently accept it as necessary and inevitable. There also seems to be a growing awareness of the increased forest fire menace, resulting from increased logging slash and large numbers of people working in the forests. Various degrees of preparation are being made to meet this danger.

MANUFACTURING WASTE

But the extent to which there is needless waste seems to be a general blind spot. Inefficient manufacture coupled with destructive logging results in a drain upon the forest which is much heavier than is actually needed for the amount of finished product that is being produced. It also results in a heavier use of man-power than would be required under more efficient manufacturing and silvicultural operations.

The waste in inefficient manufacture arises, in large part, from the necessity of remanufacturing lumber that was not sawn to specifications. After remanufacture, it is estimated that there frequently is 25 to 35 per cent. less finished product than would have been produced from the same logs by efficient original sawmilling. Because of poor manufacture, many, if not most, small operators receive much less for their product than they should be able to get if it were well manufactured. This is reflected in the wages that can be paid to labor in the forest community. Everybody loses.

Could not these losses be very substantially reduced by providing the small manufacturer with information and technical service on specifications and on how to saw to specifications? Does not the work done in the New England timber salvage provide practical experience for developing immediately a nation-wide program of

technical service and advice in sawmilling which would help to conserve forests, increase the efficiency of production, and obtain a better return to the producer?

Stumpage Waste

Another prevalent form of unnecessary waste comes in selecting the trees which are to be cut. In many forest areas, thrifty young trees are butchered, while in other areas, including much of our publicly owned forests, valuable trees, mature or over-crowded, rot to waste in the woods. Here we have, a double loss: trees rotting to waste which should be used and thrifty young trees being slaughtered which should be left to grow for the future. Again, an intensified program of technical service and information to timber operators and forest owners should be helpful. The N.R.A. lumber code experience, the New England timber salvage, the intensive farm forestry projects under the Norris-Doxey Act, and other activities provide experience that could be used in developing a more adequate program to advise and assist forest owners and operators in deciding what trees to cut.

Governmental forest regulation, to develop and enforce minimum standards of silviculture, is another step already long over-due, to reduce waste and destruction in the woods. It would at least be helpful in preventing the worst forms of devastation.

Our Forest Debt

We not only have a debt to the people of the forest regions. A forest debt has been, and still is piling up through the needless over-cutting of our forests. It is a far more serious and real thing than money debts. The latter are offset by bonds and notes which to somebody are assets. But a debt to the forest which results from unnecessary waste is an asset to no one, but a liability any way it is looked at. As a long-range job, we have a heap of work to do to pay our debt to the forests and build back the timber resources. Immediate reduction of waste in producing timber for present needs will mean that for every foot or pound of timber product manufactured, only a minimum legitimate amount is being added to the forest debts. Therefore, a program to reduce waste in current logging and manufacturing would seem to be a logical step toward balancing our timber budget. It would also help to stabilize rural

economy. Is it not the kind of step that it should be feasible to take *now*?

FOUR PRINCIPLES OF PLANNING

To summarize our discussion of "planning," four principles have been mentioned:

(1) A great deal of over-all planning is necessary because individual planning alone and un-coordinated does not produce the desired results;

(2) Planning in a democracy needs to be done not only for the people but by the people, with the aid and advice of trained experts, and with full protection of individual and minority rights;

(3) Do "first things first" but keep the long-range view;

(4) Today the obvious "first thing" in forest use is to produce the timber needed for defense; but at the same time, a program to reduce needless waste in logging and manufacture seems logical and desirable as an immediate aim of forestry planning.

SUMMARY

We have ranged far in discussing our subject. Central ideas that might be pulled out in summation are: (1) It is not enough to develop forestry knowledge: it must next be widely applied (2) The management of the forest must be *related* to the needs and to the objectives of a changing rural economy. (3) There must be the framework of a stable general economy within which to plan most effectively for forests and for rural economy. Rural economy cannot be stabilized by itself within an unstable general economy. Trying to do so is in some respects like trying to build a house in the midst of an earthquake. A number of principles which might be observed in developing a plan have been considered.

The conclusion may well be that we need to work along the forestry, rural economy and "general" lines simultaneously. We should not become too narrowly engrossed in our professional field. We don't want to be so absorbed with the forest that we fail to see the people. We can't afford to ignore the relentless tide of historic forces which has all people in its grip, and which compels us to plan together for our whole economy. We should start with "first things first" and do what we can.—*Journal of Forestry*, Vol. 39, No. 9. dated September 1941.

INDIAN FORESTER

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SOME RECORDS OF EXTREME LONGEVITY OF SEEDS OF INDIAN FOREST PLANTS

BY T. V. DENT,

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Summary.—Germination tests were carried out on old dated seed selected from exhibition cases in the museums of the Forest Research Institute at Dehra Dun. The 64 samples examined represented 52 selected species of native, naturalised or cultivated Indian plants, most of them forest trees; the seed ages varied from 7 to 62 years, the majority being above 20 years.

The oldest sample which germinated was a single seed of *Cæsalpinia digyna*, aged 41 years, which has produced a healthy flourishing plant; 24-year-old seed of the same species also germinated freely. Other long-lived seeds of the natural order Leguminosae were *Acacia farnesiana* (31 years), *Cassia fistula* (31 years), *Albizzia lebbek* (30 years), *Albizzia odoratissima* (27 years), *Dichrostachys cinerea* (26 years), *Acacia dealbata* (23 years), *Acacia decurrens* (23 years) and *Leucæna glauca* (23 years).

Long-lived seed were also found in the natural order Malvaceae, three out of the four species examined given positive results, namely,—*Hibiscus macrophyllus* (24 years), *Ochroma lagopus* (24 years, seed from America) and *Abutilon indicum* (17 years).

Three seeds of *Nelumbium speciosum* (Nelumbiaceae) from a herbarium sheet over 62 years old failed to germinate, but four seeds of the same species collected in 1935, 7 years ago, germinated with great vigour. *Nelumbium* is an aquatic herb, not a forest-plant, but it is reputed to have very long-lived seeds and carries a special interest on this account.

The imminence of his transfer from Dehra Dun has for the present prevented the writer from proceeding further with these preliminary investigations into the longevity of Indian seeds.

1. *The inception of the investigations*

The Silviculture Branch of the Forest Research Institute at Dehra Dun have under compilation a bulletin on the storage of Indian tree seeds. In the course of collecting information for a

general introduction to this bulletin, several very interesting references to recorded cases of extreme longevity of seeds were encountered. The most striking of these records are those reported from Paris by Becquerel in 1907 and 1935 and by Ewart in 1908 from Australia. Both these investigators utilized dated seed specimens from old botanical collections and museums. No viability tests on seeds of Indian species which have been kept for long periods of time in the heat of the Indian climate have so far been recorded, so the writer has taken advantage of the ample collections of dated specimens which are available in the various museums of the Research Institute to complete a few germination tests on old seed of several likely species.

2. *The limited scope of the present work.*

The seed samples examined were selected at the beginning of July, 1942, and the germination tests were started on the 18th of the month and all completed within four weeks. The results now reported are therefore the outcome of a single month's effort. However, in spite of their limited scope, these tests have yielded some very interesting information, and it is desirable that at some time the investigations be resumed and expanded to include a larger and more representative selection of species. The seed material so far examined by no means exhausts the resources of the museums of the Research Institute, but the writer is, unfortunately, obliged to drop this very interesting subject for the time being, due to his imminent transfer away from Dehra Dun.

3. *The seed material examined*

A total of 64 samples of dated seed, representing 52 different plant species, was tested. The samples were taken from dated collections of seed preserved in the Silviculture, Botany and Minor Forest Products museums, and in the Herbarium of the Forest Research Institute at Dehra Dun. The samples selected were chosen from seed lots which appeared outwardly to be in a sound condition. Samples thought to have no hope of germinating were usually avoided, whereas those kinds thought especially likely to be viable were sought out, the first object of the tests being to see whether *any* species of seed was able to maintain its viability for lengthy

periods under the relatively unfavourable conditions of climate and storage involved.

The majority of the species tested are forest trees, others are forest shrubs or climbers, and one (*Nelumbium*) is an aquatic plant of lakes and tanks. Of the total of 52 species, eleven are plants naturalized or commonly cultivated in India, and forty are natives of India and Burma. The remaining species is *Ochroma*, the Balsa of Central America the cultivation of which has several times been attempted in this country, but so far with little success. *Ochroma* is remarkable on account of the extreme lightness of its timber and the rapidity of its growth. The shortage of cork due to the war has recently brought Balsa into prominence, and it has latey been suggested that attempts should be made to grow *Ochroma* in India. It is very interesting to note that Balsa wood first assumed importance during the war of 1914—1918, and then, as now, it was suggested that the tree should be tried in India. Troup, who was Imperial Silviculturist at the time, obtained *Ochroma* seed from Central America in 1918, and subsequent tests proved it to be easily germinable, though none of the resulting seedlings were able to survive the Dehra Dun cold weather. Troup placed part of the seed he received in a glass jar in his museum at Chand Bagh. Later the silviculture museum, and the Balsa seed along with it, was transferred to the present building at the New Forest, where the glass bottle with its enclosed seed is still on view in the seed-exhibit case. When a small quantity of Troup's *Ochroma* seed was soaked and tested in July, 1942, over 80 per cent. of it germinated in a few days and healthy young Balsa seedlings have resulted.

With the exception of *Ochroma* all the seed samples tested were produced within the limits of India and Burma. In most cases the exact locality of collection is recorded on the original museum label.

The age of the seed samples at the time of the germination tests varied from 7 to 62 years, and included seed of over 20 years of age for 44 out of the 52 species examined.

4. *Storage history of the samples*

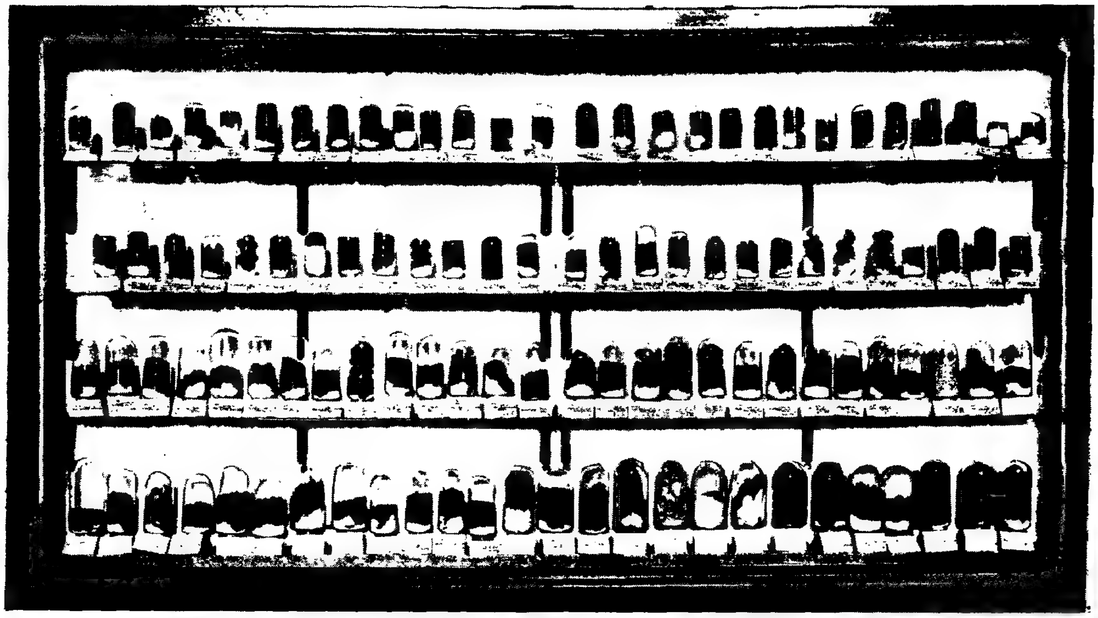
All the 64 samples of seed tested were from carefully labelled and dated specimens preserved in the various museums and collections

of the Forest Research Institute (*vide* Plate 33, Fig. I). The method by which the seed was stored varied in the different museums, but in no case was the manner of storage especially designed to secure the continued retention of seed-vitality. In most cases the seeds were exposed to full light, and to the relatively free circulation of air. The site of storage of each sample is shown in column 7 of the statement of results. The actual conditions in each of these sites were as follows:

Site of storage.	No. of samples provided.	Manner of storage.
Silviculture museum. ..	25	Small bottles, with glass stoppers, often loose. Exposed to full light in a glass exhibition case.
Minor Forest Products museum ..	17	Open wooden boxes, exposed to full light and air in a glass exhibition case.
Botany museum	12	In glass bottles, with loose tops and an enclosed camphor ball. In full light in an exhibition case.
Assistant Botanist's room ..	5	In small glass phials with corks On the sill of a large window facing north. Very strong light.
Herbarium	5	On mounted sheets, kept in folders in the herbarium cabinets. Painted over annually with chemicals to prevent insects and fungi. Seeds within pods or capsules.
Total number of seed samples tested	64	

The climatic conditions at Dehra Dun are typical of Indian monsoon regions. There are no devices in the museums of the Institute to modify the intensity of the normal fluctuations of atmospheric temperature and humidity, and the recording of the adjacent meterological station may be taken as representative, to within one or two degrees, of climatic conditions which prevail within the museums.

Fig. I



The Stored Seed

Part of the seed-collection case in the Silviculture Museum, from which 25 of the samples tested were obtained.

Fig. II

Apparatus to Test Viability

To the Left: Grunwald's apparatus with 23-year-old *Leucaena glauca* seed germinating.

To the Right: Apparatus for germinating seed between moist blotting paper. Upper sheet of blotting paper removed to show germinating seeds of *Acacia farnesiana*, 31 years old.

Temperature and Humidity data for Dehra Dun
Average of the 5 years 1937 to 1941

Month.	MEAN TEMP. °F.		ABSOLUTE EXTREME TEMP. °F.		Mean Humidity. per cent.	Rainfall (av. of 60 yrs.) Inches
	Max.	Min.	Max.	Min.		
January ..	67	40	77	32	81	2·3
February ..	69	44	80	32	79	2·5
March ..	79	50	93	40	63	1·4
April ..	90	58	105	43	46	·7
May ..	97	68	107	51	46	1·4
June ..	93	71	105	57	72	8·2
July ..	87	72	96	63	86	26·1
August	86	72	94	68	89	27·6
September ..	86	67	91	54	82	10·8
October ..	84	57	90	44	72	1·1
November ..	76	45	83	35	69	·4
December ..	70	40	76	33	80	·9
					Average Annual Rainfall =	83·4″

It is thus seen that Dehra Dun experiences considerable extremes of temperature and humidity. High temperature and high humidity are factors which have a distinctly inimical effect on the powers of seed to retain their vitality. We therefore expect to get less spectacular records of the extreme longevity of seeds under Dehra Dun conditions that those reported from places which enjoy a more temperate climate.

5. *Method of testing seed viability*

The germination tests were conducted in the glass-roofed seed-testing shed in the Silviculturist's experimental garden at Dehra Dun. The primary object was to coax into life any seed which yet retained a dormant living embryo, no matter what the care and attention required. In all cases the seeds were given a preliminary soaking in cold water before being placed in the germinators. The majority of the seed had hard coats, impermeable to water, and in many cases each individual seed had to be filed by hand before it could be persuaded to swell and absorb that water which is always an indispensable preliminary to germination. The germination apparatus used was varied to suit the size of the seed. After the initial absorption of water had been secured, the small seeds were germinated between pads of moist blotting paper; those somewhat larger were tested in Grunwald's apparatus, which consists of a

moist porous pot base covered by a glass belljar (*vide* Plate 33, Fig. II), the very large seeds were sown in trays in a medium consisting of equal parts of coarse sand and garden soil. Each sample of seed, almost in fact each individual seed, was attended to daily during its testing period. Germination was recorded as it occurred, and germinating seeds were removed to pots or trays so that they could be grown up into larger plants, and their future development watched and recorded.

6. *The results of the germination tests*

The details of the 64 samples tested and the results obtained are given in the table below. Of the 52 species tested no less than 37 were of the *Leguminosae,* a family notorious for the longevity of its seeds. Seeds of eleven species of this family germinated (*vide* Plate 34, Figs. I & II), nine of them with ages of over 20 years; *viz.*

Caesalpinia digyna	...	41 years old.
Acacia farnesiana	...	31 ,, ,,
Cassia fistula	...	31 ,, ,,
Albizzia lebbek	...	30 ,, ,,
Albizzia odoratissima	...	27 ,, ,,
Dichrostachys cinerea	...	26 ,, ,,
Acacia dealbata	...	23 ,, ,,
Acacia decurrens	...	23 ,, ,,
Leucaena glauca	...	23 ,, ,,

The only other family which gave germination from really old seed was *Malvaceae,* in which three out of four species tested proved germinable, *viz.*

Hibiscus macrophyllus	...	24 years old.
Ochroma lagopus	...	24 ,, ,,
Abutilon indicum	...	17 ,, ,,

Nelumbium speciosum was specially sought out for testing, because the seed of this species has already been recorded as capable of retaining its viability for an exceptionally long time. Three seeds were obtained from a sheet in the herbarium which was inscribed "Presented from the collection of D. Brandis—1880." These seeds proved to be infertile, the kernel being shrunk and fungus attacked in the vicinity of the micropyle. Four seeds of the same species collected only 7 years ago, germinated rapidly in a pot of water after the seed coat had been pierced by filing.

Fig. I

Fig. II

Month-old seedlings of *Acacia farnesiana* (Fig. I) and *Cassia fistula* (Fig. II) both raised from 31-year-old seed from the Silviculture Museum.

RESULTS OF GERMINATION TESTS ON OLD SEED SAMPLES

(*=Cultivated exotics or naturalised plants)

Sl. No.	Species and Family.	Age of seed in years.	No. of seed tested.	% germination obtained.	Where Stored.	Remarks.
	BIXACEAE					
1.	***Bixa orellana**, L.	47	150	—	M. F. P. museum	Seed quite rotten.
	CELASTRACEAE					
2.	**Celastrus paniculata**, Willd.	20	140	—	Do.	
	EUPHORBIACEAE					
3.	***Jatropha curcas**, L.	33	25	—	Do.	Appeared sound, but gave no sign of germination.
4.	**Mallotus philippinensis**, Muell.	48	72	—	Do.	
5.	**Putranjiva roxburghii**, Wall.	11	33	—	Do.	Seeds have the appearance of being sound inside, but germination cannot be induced.
6.	***Sapium sebiferum**, Roxb.	30	100	—	Silva. museum	
	LEGUMINOSAE.					
7.	**Abrus precatorius**, L.	33	89	—	Bot. museum	All but one seed permeable within 24 hours.
8.	**Acacia arabica**, Willd.	31	100	—	Silva. museum	
9.	**Acacia catechu**, Willd.	27	100	—	Do.	Seed quite rotten.
		21	100	—	Do.	
10.	**Acacia concinna**, DC.	33	8	—	M. F. P. museum	
		32	17	—	Do.	
11.	***ACACIA DEALBATA**, Link.	23	85	14	Silva. museum	47 permeable seeds did not germinate. 38 seeds resisted soaking, until filed after 3 weeks; 12 of these then germinated.
12.	***ACACIA DECURRENS**, Benth.	23	250	4	Silva. museum	Half permeable, and half had to be filed; of each class, 5 germinated.
13.	***ACACIA FARNESIANA**, Willd.	31	65	40	Do.	35 permeable of which only 4 germinated. 30 impermeable, filed after 3 weeks' soaking and gave 22 seedlings.
14.	**Acrocarpus fraxinifolius**, Wight.	7	145	4	A. B's. office room	Majority are impermeable until filed.
15.	***Adenanthera microsperma**, T. & B.	7	48	—	Do.	All seeds impermeable, but viability nil.
16.	**Albizzia amara**, Boivin.	24	25	—	Bot. museum	Seed of doubtful quality.
17.	**ALBIZZIA LEBBEK**, Benth.	30	85	5	Silva. museum	Some permeable after several days' soaking without filing; others had to be filed.

RESULTS OF GERMINATION TESTS ON OLD SEED SAMPLES

(*=Cultivated exotics or naturalised plants)

Sl. No.	Species and Family.	Age of seed in years.	No. of seed tested.	% germination obtained.	Where Stored.	Remarks.
18.	**ALBIZZIA ODORATISSIMA,** Benth.	27	175	1	Bot. museum	Some seed permeable, others need filing.
19.	**Bauhinia racemosa,** Lam.	30	30	—	Silva. museum	The majority very hard impermeable seed, very resistent to soaking. Have the appearance of being viable seed, but no germination could be obtained.
		29	100	—	Do.	
20.	**Caesalpinia bonducella,** Flem.	50	19	—	M. F. P. museum	Several impermeable seed looked quite sound inside and had every appearance of being viable.
		33	10	—	Do.	
21.	***Caesalpinia coriaria,** Willd.	24	100	—	Silva. museum	
22.	**CAESALPINIA DIGYNA,** Rottler.	60	2	—	Herbarium	
		41	1	(100)	M. F. P. museum	Impermeable until filed. A very healthy seedling.
		24	27	63	Silva. museum	Permeability variable. All viable seed have produced very healthy plants.
23	**Caesalpinia nuga,** Ait.	27	2	—	Herbarium	Seeds appear sound, but do not germinate.
24.	**Caesalpinia sappan,** L.	28	16	—	Silva. museum	
25.	**Caesalpinia sepiaria,** Roxb.	44	4	—	Herbarium	
26.	**Cassia absus,** L.	42	330	—	M. F. P. museum	All permeable.
27.	**Cassia auriculata,** L.	25	150	—	Silva. museum	A few non-viable seed permeable to water.
28.	**CASSIA FISTULA,** L.	31	60	33	Do.	The remainder highly impermeable until filed.
29.	**Cassia tora, L.**	28	51	—	Herbarium	All permeable.
30.	***Ceratonia siliqua,** L.	51	43	—	M. F. P. museum	Some of the seed was impermeable.
31.	**Dalbergia cultrata,** Grah.	30	73	—	Silva. museum	
32.	**Dalbergia latifolia,** Roxb.	31	200	—	Do.	
33.	**Dalbergia oliveri,** Gamble.	29	12	—	Do.	
34.	**DICHROSTACHYS CINEREA,** W. et A.	26	250	12	Do.	Loose seed. 20% impermeable; these swell after filing and give good germination.
		26	50	—	Do.	Seed in pods. All permeable and non-viable.
35.	**Entada scandens,** Benth.	53	2	—	M. F. P. museum	Impermeable and appeared sound, but rotted after filing and swelling.

36. **Hardwickia binata**, Roxb.	14	8	—	Bot. museum	
37. ***LEUCAENA GLAUCA**, Benth.	**23**	**150**	**50**	Silva. museum	Nearly all seed very impermeable. Swell and germinate rapidly after filing.
38. **Parkia roxburghii**, G. Don.	7	10	—	A.B.'s office room	
39. ***Poinciana pulcherrima**, L.	7	35	40	Do.	
40. **Pongamia glabra**, Vent.	34	17	—	M. F. P. museum	Oily seed—unlikely to be long-lived.
41. **Prosopis spicigera**, L.	50	45	—	Do.	Many seed impermeable to water. Appear sound, but quickly rot after filing and swelling.
	30	90	—	Silva. museum	
42. **Tamarindus indica**, L.	28	20	—	M. F. P. museum	A few seed impermeable, but non-viable.
43. **Xylia dolabriformis**, Benth.	30	34	—	Silva. museum	All permeable.
MALVACEAE					
44. **ABUTILON INDICUM**, G. Don.	**17**	**85**	**71**	Bot. museum	Seed stored in capsules. Majority impermeable and must be filed before water is absorbed.
45. **HIBISCUS MACROPHYLLUS**, Roxb.	**24**	**200**	**1**	Do.	About 20% impermeable to water.
46. **Kydia calycina**, Roxb.	22	60	—	Do.	25% impermeable, but non-viable.
47. ***OCHROMA LAGOPUS**, Sw.	**24**	**100**	**80+**	Silva. museum	Permeable in water, and quickly germinate. Very few non-viable seed.
NYMPHACEAE (Nelumbiaccae)					
48. **Nelumbium speciosum**, Willd.	62+	3	—	Herbarium.	Seed withered and degenerated at the end opposite the micropyle.
	7	4	100	A. B's. office room	Impermeable. Must be filed. Very vigorous.
STERCULIACEAE					
49 **Sterculia palens**, Wall.	21	50	—	Bot. museum	
50. **Sterculia urens**, Roxb.	23	29	—	Do.	
	10	51	**	Do.	**Seeds appear very sound inside, but soften and rot after soaking. One seed apparently started to germinate before rotting.
URTICACEAE					
51. **Ficus infectoria**, Roxb.	7	1500	—	A. B.'s office room	
VERBENACEAE					
52. **Tectona grandis**, L.	31	30	—	Silva. museum	Fruits. Some seed, even in the 31-year-old sample, appeared quite sound when the fruit was broken open. Germination, however, could not be induced.
	13	70	—	Bot. museum	
	10	16	—	Do.	

7. *Subsequent development of plants from viable seeds*

The subsequent development of these seeds which, after a quarter of a century or more of complete dormancy, have at length been coaxed into active life is a subject of considerable practical interest. Has the vitality and strength of the tiny resting plant-embryo been impaired by the long years of static inaction? Can the 30-year-old viable seed develop into a normal healthy plant, comparable in strength, vigour and all other respects to that which will arise from a freshly matured seed? This aspect of the problem has doubtless been specifically studied to some extent already but the subject receives scant attention in standard works of reference, such as those of Stiles and Molisch.

Working with Javan forest plants, Eidmann found that when several lots of seed of the same species were tested, the general rule was: *The lower the germinative capacity, the higher the seedling death-rate; the higher the germinative capacity, the lower the subsequent death-rate.* This general rule was found to apply to cases of lowered vitality due to storage, for example the germinative capacity of *Phyllanthus emblica* seed sown 2½ months after collection was 71 per cent. and the subsequent seedling death-rate was 4.1 per cent.; some of the same lot of seed sown 8 months after collection germinated to the extent of only 20.5 per cent., while the seedling death-rate rose to 47.8 per cent. In the same way the results of tests of *Dalbergia latifolia* seed which had been stored for periods of 4, 5, 6, 7 and 8 months showed a progressively declining germinative capacity of from 41.5 to 18.8 per cent., while the corresponding seedling death-rate rose steadily from 9.1 per cent. to 23.4 per cent. Similar close inverse relationships of germinative capacity with mortality per-cent were obtained for *Dalbergia sissoo,* with monthly tests made on seed stored for periods of from 2 to 15 months.

Eidmann did not work with seed that had been stored for more than two years, so that we are unabe to say whether the same general rule holds true for very old seeds, where the germinative

Fig. I

Fig. II

Month-old seedlings of *Caesalpinia digyna* from 24-year-old seed (Fig. I) and of *Albizzia lebbek* from 30 years old seed (Fig. II).

capacity may have fallen to a very low level through extreme age. It is too early to draw any conclusions from the results of our Dehra Dun tests, for at the time of writing the seedlings which we have raised are only one month old. It is, however, intended that as many plants as possible be raised from the old seed which has germinated, so that the subsequent growth of the plants may be watched. This duty has been entrusted to Mr. E. Joseph, who is in charge of the experimental garden at Dehra Dun, and it is hoped that he will, in due course, report developments. At the age of one month, the seedlings of the majority of the species which have germinated have every appearance of robust health, as may be seen from plates 34 and 35, which depict month old seedlings of *Acacia farnesiana* (31 years), *Albizzia lebbek* (31 years), *Cassia fistula* (30 years) and *Caesalpinia digyna* (24 years).

8. *World records of seed longevity*

For the sake of comparison with the results obtained at Dehra Dun, all those world records of extremes longevity of seeds which are available in the institute libraries have been consulted and the list given below prepared. The list includes every authentic recorded instance of viable seed of over 30 years of age which could be traced. As regards the maximum records at the head of the list, those quoted probably include all the generally accepted world records for longevity, but the lower portion of the list is undoubtedly very incomplete. EWART'S original articles are not available at Dehra Dun. On the completion of his investigations on the longevity of seed in 1908, he prepared a list of all those species of plant of which he was able to germinate seed at ages of from 15 to over 100 years old. This list included 180 varieties of seed, among which it is not known how many were over 30 years old; nine of his records are included in our list, the information having been extracted from other publications.

World records of seed longevity.

Serial No.	Species.	Family.	Age of seed at time of germination.	Authority.
1	Nelumbium speciosum	Nelumbiaceae	237 years	Ramsbottom.
2	Nelumbium nucifera	do	160-250 ,,	Ohga (ex. Stiles)
3	Cassia multijuga	Leguminosae ..	158 ,,	Becquerel.
4	Albizzia julibrissin	do	147 ,,	Ramsbottom.
5	Cassia bicapsularis	do	115 ,,	Becquerel.
6	Goodia lotifolia	do	105 ,,	Ewart.
7	Hovea heterophylla	do	105 ,,	do
8	Leucaena leucocephala	do	99 ,,	Becquerel.
9	Dioclea pauciflora	do	93 ,,	do
10	Cytisus biflorus	do	84 ,,	do
11	Mimosa glomerata	do	81 ,,	do
12	Melilotus alba	do	77 ,,	Ewart.
13	Stachys nepetaefolia	Labiatae ..	77 ,,	Becquerel.
14	Trifolium arvense	Leguminosae ..	68 ,,	do
15	Ervum lens	do	65 ,,	do
16	Lavatera pseudo-olbia	Malvaceae ..	64 ,,	do
17	Cytisus austriacus	Leguminosae ..	63 ,,	do
18	Abutilon avicennae	Malvaceae ..	57 ,,	Ewart.
19	Acacia diffusa	Leguminosae ..	57 ,,	do
20	Acacia penninervis	do	57 ,,	do
21	Hibiscus trionum	Malvaceae ..	57 ,,	do
22	Nelumbium codophyllum	Nelumbiaceae	56 ,,	Becquerel.
23	Melilotus luteus	Leguminosae ..	55 ,,	do
24	Nelumbium luteum	Nelumbiaceae	55 ,,	Ewart.
25	Acacia distachya	Leguminosae ..	53 ,,	Becquerel.
26	Cytisus albus	do	51 ,,	Ewart.
27	Nelumbium asperifolium	Nelumbiaceae	48 ,,	Becquerel.
28	Cassia glauca	Leguminosae ..	43 ,,	Bertha Rees.
29	Acacia acinacea	do	40 ,,	do
30	Crotalaria ramosissima	do	39 ,,	Becquerel.
31	Nomismia mummularia	do	38 ,,	do
32	Astragalus brachyceras	do	38 ,,	do
33	Dolichos funarius	do	37 ,,	do
34	Acacia cornigera	do	37 ,,	do

It is interesting to note the plant families which contribute records to the above list. Of the 34 items included, no less than 25 belong to the *Leguminosae*. The Lotus family, *Nelumbiaceae*, contributes five records, two of which head the list, while the total is completed by three species of *Malvaceae* and a single record from the *Labiatae*.

Ewart, during the course of his investigations, examined 2,500 varieties of seed of various ages from 15 to over 100 years old, and found that of the 180 species which proved germinable, no less than

75 per cent. belonged to the *Leguminosae*, including 30 species out of 50 tested, of the genus *Acacia*. Next to *Leguminosae*, the natural orders which gave the greatest number of long-lived seed were *Malvaceae* and *Myrtacae*.

The list given above includes all Bequerel's extreme records. Like Ewart, he found that by far the greatest number of long-lived seeds belong to plants of the natural order *Leguminosae*. Other families providing viable seeds of over 25 years old were *Nelumbiacae Malvaceae* and *Labiatae*.

Ramsbottom's two records were quoted in a very recent note in "Nature". He got one 237-year-old seed of *Nelumbium speciosum* to germinate,—a single seed taken from the same receptacle that supplied Robert Brown with the 150-year-old material from which he obtained germination during his classical investigations in 1843—55. The 147-year-old *Albizzia julibrissin* seed germinated "spontaneously" in the South Kensington museum after being wetted accidentally following damage by enemy bombs.

Incidentally, it may be noted that supposed records of the germination of "mummy" wheat from Egyptian tombs cannot be substantiated when enquired into critically. All such seed, whether of cereals or other agricultural crops, lost its vitality centuries ago. Stiles and Molisch discuss the subject at some length, and completely explode the popular belief that seed from ancient tombs is sometimes viable.

It is probable that many kinds of impermeable seeds retain their vitality when buried in the soil for very long periods of time—probably longer than when under artificial museum conditions. Various interesting investigations into this aspect of seed longevity are summarised and discussed by Stiles and Molisch. The chief trouble with most investigations regarding old buried seed is the difficulty in fixing ages with any degree of certainty.

As has already been stated little previous information is available regarding the longevity of the seeds of Indian plants when stored under Indian climatic conditions. Sonavne has reported some interesting preliminary data on the longevity of Indian crop seed. Seed samples of 16 of the most important agricultural plants of Bombay were placed in sealed tins in 1922; one sealed tin of each

kind was opened yearly for the purpose of making four 3-monthly germination tests. The results of these tests to the end of the first five years were published in 1928, up to which time all the 16 species had maintained a relatively high germinative capacity. The ultimate results achieved by this storage test are not known.

9. *The practical utility of seed longevity tests*

A knowledge of the age to which live seeds are able to lie dormant in storage or in the soil is of very great academic interest to those who are studying problems of plant physiology and reproduction, and indeed to all who are interested in problems of plant life, from the ecologist or the biologist engaged on fundamental research down to the amateur gardener. Beyond the academic is the practical aspect, and here too a, knowledge of the extent to which, and the conditions under which, any particular seed may retain its viability is of the real value. The Forester who remembers that the seed of many species of *Leguminosac* will store in excellent condition for years will know that his *Acacia* or *Cassia* seeds will not quickly loose their viability; he will know also that the seed character which insures this long life is a hard tough seed-coat which is often quite impervious to water, an obstacle which *must* be overcome successfully if the dormant embryo is to be stimulated to resume its interrupted life. How often are reports of failed sowings of hard-coated seeds due to poor seed and how often to poor cultural technique? An intimate knowledge of the basic principles of seed longevity and development will go far to help solve not only our plantation and nursery problems, but also those of our natural regeneration areas.

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WAR EFFORT OF TEHRI GARHWAL STATE FOREST DEPARTMENT (1939—1942)

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Soon after the declaration of war by the British Government in 1939, His Highness the Maharaja of Tehri Garhwal State offered all the resources of the State, over and above his own, and the Heir-apparent Teeka Sahib's personal services to the British Government for the prosecution of the war to a victorious and glorious end.

Out of about 4,500 square miles, the total area of Tehri Garhwal State, the demarcated reserved forests cover 3,544 square miles. Consequently, the forests, forming the chief and major resources of the State, came immediately under review for the supply of timber and other produce for war purposes.

The preliminary investigations resolved along two channels, *viz.*

(1) Inspection of those virgin forests of the State, which for some difficulty or the other remained unexploited in the past; and

(2) Reorientation of the felling schemes of the Working Plans of the forests for providing maximum output of timber.

The inspection of the forests began with a tour of His Highness through the central portion of the State forests comprising the Utterkashi Forest Division. Simultaneously, Teeka Sahib inspected some of the forests in the Tehri Forest Division which

comprised the eastern and southern parts of the State. The forests in the north, *i.e.* of the Jamuna-Tons Forest Division were similarly inspected by the Conservator of Forests. The fact that these inspections were made in October, 1939, shows the promptitude with which the work was started and the fact that both His Highness and the Teeka Sahib inspected the forests personally, indicates the supreme importance attached to this work. These inspections were valuable inasmuch as the problems of the difficult forests were studied on the spot, and ways and means were found to remove the difficulties which prevented their exploitation in the past.

All the demarcated reserved forests of the State are under sanctioned Working Plans. Their prescribed annual yield makes a total of 24,22,250 c. ft. of *chir, deodar* and *kail*. Of this 1,22,250 c. ft. are used to provide freegrants to local people and for departmental works. So, 23,00,000 c. ft. nearly is annually felled for export.

Actually, however, there were under-fellings in the past. So, for 1940—41 fellings there was enough reserve and excess-felling was not necessary. For 1941—42, felling over and above the prescribed volume yield was made possible by an order permitting advance fellings during the period of war. In this way, the volume of timber exploited during the last three years is as follows:

1939-40:	*chir, deodar* & *kail*	...	16,47,955 c. ft.	Marked before the war was declared.
1941-42:	do.	...	29,08,250 „	
1941-42:	do.	...	26,31,471 „	
	Total	...	71,87,676 c. ft.	

Thinnings were done in the past but their material was utilized locally and was very seldom exported. The difficulties of their economic exploitation and extraction were overcome by judiciously locating thinnings in areas adjacent to the main fellings and confining them with 1½ miles of the main floating streams. This

material was exported in the standard sizes of *ballies* (poles) 12 ft.—16 ft. x $3\frac{1}{2}$ in. to $5\frac{1}{2}$ in. diameter. The total timber volume exported in this way is as below:

1940-41:	From *chir, deodar* & *kail* trees under 16 in. diameter	...	4,26,570 c. ft.
1941-42:	do.	...	6,07,660 c. ft.
	Total	...	10,34,230 c. ft.

The silver fir and spruce forests of the State had no market in the past and so, for them no felling plan was drawn up in the Working Plans which only prescribed their general protection. Felling schemes for these forests were, therefore, hastily drawn up and their exploitation started in 1939-40. The total volume of timber felled in these forests is as below :

1939-40:	Silver fir and Spruce	...	3,30,000 c. ft.
1940-41:	do.	...	31,61,105 c. ft.
1941-42:	do.	...	26,53,820 c. ft.
	Total	...	61,44,925 c. ft.

From the above it can be summed up that the total volume of coniferous timber felled during the last three years (1939-40 to 1941-42) for war purposes is, as under:

Main fellings	... ...	71,87,676 c. ft.
Thinnings	... ...	10,34,230 c. ft.
Silver fir and spruce	... ...	61,44,925 c. ft.
Grand Total	...	1,43,66,831 c. ft.

The above is the main contribution of the Forest Department towards total war effort of the State. The next item of importance is resin supply. Resin tapping operations were started in *chir* forests within easy reach of motor roads of the Tehri Forest Division in 1938-39, when 5,000 maunds of crude resin was exported on monopoly system. During the last three years of war this work was vigorously pushed ahead and it resulted in the export of about 37,000 maunds of crude resin. Lately, the areas under tapping have been almost doubled and considerably higher resin output is expected in future.

A number of other forest produce have, also been exported for war purposes but they are of minor significance. For example, bamboos for tent poles and other uses, low level *kukat* for tent poles, charcoal, etc., and medicinal herbs.

Special mention may be made here regarding the supply of walnut and maple wood. Early in 1939 an inquiry was received from the Secretary, Principal Supply Officers' Committee (India), New Delhi, regarding supply of walnut wood in connection with the re-armament programme. Later on, under advice of the Railway Board some specimen planks of walnut and maples were sent to the Superintendent, Rifle Factory, Ishapur (Bengal), for inspection and preliminary tests. These samples having proved satisfactory 1,000 walnut and 1,500 maple trees of over 7 ft. and 4 ft. girths, respectively, were sold for supply of their timber for rifle furniture.

To cope with the growing correspondence in connection with the supplies of the various forest produce for war purposes, it was found necessary to create a separate Secretariat for the Forest Department under a Forest Secretary at the Government Headquarters at Narendranagar. A wholetime Forest Secretary who also happens to be the Conservator of Forests, is, therefore, dealing with the all-important problem of the day.

NYAUNGWAING DEPOT

BY A. LONG, E.A.C. FORESTS, BURMA

Introduction.—The Depot and Agency Division holds a monthly auction of teak timber at Rangoon.

Subject to the demands of the market, the policy is to sell about 3,500 tons monthly. The average monthly sales for the three years, 1936-37 to 1938-39, were as follows:

1936-37	...	2,650 tons
1937-38	...	3,415 „
1938-39	...	3,120 „

This timber comes from the Tharrawaddy, Zigon and Prome Forest Divisions and is extracted by the Myitmaka Extraction Division.

Each year in May, the Divisional Forest Officer, Depot and Agency Division studies the coming year's requirements having due regard to the following factors:

(*i*) balance stock of timber of the previous year, of the different star classes;

(*ii*) average monthly sales;

(*iii*) Myitmaka Extraction Division output.

He sends his requirements to the Myitmaka Extraction Division and the logs are rafted down from the M.E.D. depots to Nyaungwaing, the storage depot for Rangoon.

The following shows the quantities requisitioned and received during the four years ended 1939-40:

Year	*Requisitioned*		*Received*			
	Logs.	Tons.	Logs.	Tons.		
1936-37	36,000	40,000	39,734*	41,217*	*Excl.	165 Rej.
1937-38	30,910	31,500	31,681	36,990		
1938-39	31,200	27,000	31,598*	33,998*	*Excl.	100 Rej.
1939-40	34,000	37,100	37,035*	37,314*	*Excl.	95 Rej.

Rafts of timber of the required star classes are sent down the Hlaing or Rangoon River, generally in two batches in a normal year; once early in the rains, about July-August and again about the end of the rains, about October.

The despatch of rafts is dependent on the level of the Irrawaddy River during the rainy season. The flood rises of this river at this time cause a backing up and cessation of flow of the water in the Myitmaka River and its feeders. During this flood or *laha* period all rafting from the Myitmaka depots to Nyaungwaing has to be held up. In normal years these *laha* periods are not of long duration. During 1938-39 rises in the Irrawaddy were not only extremely heavy but were very protracted and rafts on the Myitmaka were held up in some cases for months over the normal period.

In 1938-39 after a raft of 1,003 logs was received on 10th July, remaining rafts were held up till 8th October, 1938. In 1939-40 owing to the abnormal flood conditions, the rafts all arrived about the same time, the first arrivals being received on 1st October, 1939. In 1940-41, conditions being more normal the first arrivals were received on 11th July, 1940.

Situation.—Nyaungwaing Depot is situated on the same bank of the Hlaing River as Rangoon itself. It lies east of the village of the same name about 2 miles south east from Tantabin, the headquarters of the Tantabin Township.

Short History.—It was used first as a temporary storage depot in 1914 during the Great War when the departmental launch was requisitioned by the Military authorities. Later, in 1915, as land in Rangoon was considered far too valuable for a timber depot, steps were taken to obtain a permanent depot here.

Sanction to the transfer to the Forest Department of a stretch of land from the Leikchaung Grazing Ground was obtained in 1923, and in 1925 a further area along the Tu or Dundabet Chaung was obtained. The land is to revert to a Grazing Ground if and when it is no longer required for the storage of timber.

Topography.—Nyaungwaing Depot, unlike Rangoon Depot with its Sale Ponds, is a tidal depot, the topography of which does not remain the same for any great length of time. The area has silted up a great deal since its formation and now consists of a stretch of mud flats intersected by a number of small streams which drain the Grazing Ground.

Levels are high inland and the land slopes down to the streams and the foreshore, imperceptibly in places but comparatively steeply near the streams and in places on the foreshore. Excluding the more obvious differences in levels, it is difficult to distinguish between high and low ground as the differences are small and the area is covered with a species of long, coarse grass.

Division into Guards.—The Depot is about a mile long from east to west and varies in effective width from about 150 feet at its narrowest part in Guard No. 4 in the east to about 450 feet at its widest part in Guard No. 9. Guards Nos. 4 to 9 are situated on the Hlaing River and Guard No. 10 in the Tu or Dundabet *Chaung,* which forms the western boundary of the depot.

The capacity of the depot varies with the seasons; being about 42,500 logs in the fine weather months (November to May) and about 30,000 logs in the rainy season.

Late 'arrivals' which are received after October have to be kept outside the outermost piles for want of space inside the depot, but

the logs are safe inside the chain boom as the river is comparatively calm during the period, November to May. With the change to monsoon weather, however, what was safe before now becomes unsafe and the outside logs have to be brought inside the 'piled' area.

Problems of the organization.—As Nyaungwaing is primarily a storage depot, the problems which exercise the staff are mainly those of storage and deliveries to Rangoon which are affected by the topography of the depot. It is essential to know which is high and which is low ground because this has a bearing on the size of the logs that can be stored. Small differences in level, even of a foot, affect the above factors. Obviously it would not do to place large logs on high ground where they would be stranded in the hot weather and could not be brought out till the following rains.

The aim of the organization generally is to place the large logs in low places and the small logs on the higher levels; earlier despatches in areas where they will float at high tide in accessible places near the foreshore and the later despatches farther in.

In order to assist the Range Officer, who hitherto has had to draw on his long experience of the depot, levels at each pile, of which the depot has 187, have been measured. These heights are relative heights based on the height of the tides at Rangoon. Knowing the relative height of the depot, the height of the tide when the new arrivals are received and the average girth of the logs in the raft he is now better able to plan where each raft should be placed having due regard to deliveries to be made to Rangoon of the different star classes.

Other problems that exercise the mind of the staff are concerned with labour-saving measures and how best to utilize the labour at its disposal. At present, the star classes are scattered all over the depot, necessitating much expenditure of time and labour in collecting logs of a specified star class for despatch to Rangoon. It would be ideal to store all the four-star logs in one guard, the three-star logs in another and so on; but much time would be required to sort them out in this way. Also such a general post of logs would upset the guard books, necessitating many inter-guard transfers, which is not desirable. This problem has been partially solved by separating the star classes in each guard.

Labour.—The quasi-permanent staff consists of a range officer, two deputy rangers and two depot overseers. One of these two depot overseers is lent to the Myitmaka Extraction Division for a great part of the year during the rafting season and is stationed at Taguzeik to check rafts.

The permanent staff consists of four foresters, who are not much better than daily labour coolies. They were appointed prior to the re-organization of the Utilization Circle Staff.

The daily labour staff consists of about 31 men divided into five classes, A, B, C, D, and E, according to their worth. In addition to the above, a few extra hands are taken on for the classification season which commences as soon as the first rafts are received from the Myitmaka Extraction Division.

Their duties range from purely mechanical work such as checking rafts and numbering logs to work which requires some measure of intelligence such as measuring and assisting the Classification Officer. Some of these men from their close acquaintanceship with logs can tell the quality and class of a log as well as, and sometimes better than, the so-called expert. They know it by experience, and this is not to be wondered at considering that most of the men have over ten years' service.

The staff, generally, are a cheerful lot considering the nature of the work they have to do which sometimes necessitates their turning out at 2 a.m. or 3 a.m. during high tides pushing out logs to be sent down to Rangoon. Whether they are working in the mud, either digging up "sunks" or probing defects of logs or working on the log, measuring, numbering or rolling them is all one to them. And if, as sometimes happens, one of them slips and falls into the river he comes up smiling, saying he did not realize the log was so slippery.

It may be interesting to enumerate what has to be done when the new rafts come in, describing one of the operations, say classification, which is not a very common operation, in some detail, later.

Rafts arrive on an ebb tide and are admitted into the allotted guard on the next convenient flood tide. The Range Officer then arranges to have the logs in the raft checked against the removal pass. When he is satisfied that everything is in order he takes over

the raft and issues a receipt for them to the raft *gaung*. He then sends an arrival report of the logs received to the divisional office, Rangoon. The logs are then serially numbered, first in coal tar, and then both in English and in Burmese with numbering cogs on a *hmandit* cut near the mid point of the log. The year of the series is impressed between "N"s (which denotes Nyaungwaing) below the serial number. They are then measured and their hammer marks picked up. These and the measurements are entered in a special form, in detail, for each arrival report. These operations are followed by classification.

Classification.—This is based on the instructions contained in D.I. para 213 and in the Forest Economist's Blue Book on Classification and is carried out by the Depot Assistant, Nyaungwaing.

The logs are first tentatively classified when the tide is out and about three-quarters of the log is visible. The holes are probed at this time, both on the ends as well as on the surface of the log, which is looked at from both ends to get an idea of its straightness, freedom from curves, knots, etc. The dimensions of the log being then called out the officer decides, tentatively, its star class which is then marked on the log with lime. In this manner he looks at all the logs of the arrival report, at the same time marking the tentative classification on the original measurement statement which will be sent to Rangoon, when their final classification is carried out.

The next operation is to have the logs rolled and this is done when the tide is in. The classification party on this occasion consists of the officer-in-charge, the booking clerk, who enters the classification in the measurement statement—he is sometimes an A class or B class labourer who has experience of the work—two labourers with peavies and two men with hammers. One hammer man wields the 'star' hammer and the 'quality' hammer (1, 2, & 3) while the other holds the 'R.P.' (royalty paid) and the 'D.S.' (Double Star denoting rejection standard) hammers. In addition, there is usually a man with probes in case these are required.

The classification officer stands, or rather balances himself on a log so that he can get the best possible view of the log

to be rolled. Generally, this is an end-on view. The log is then rolled slowly so that he sees the whole surface when he is able to give it its classification. Generally speaking, this classification falls below the tentative classification first made, but in a few rare cases, when the log rolls up a sound lower surface, this tentative classification may be raised.

The work can become very absorbing as, although the logs have to be classified within broad, fairly well defined limits, no two logs, like no two leaves or no two thumb imprints are alike: each log presents a problem of its own. How true this is will be seen if we consider one of the obvious characters of the log, for instance, its shape. Although the Forest Economist has reduced this problem in his Blue Book to a range of two defects, from the cylindrical to the triangular, a moment's reflection will show, (and this is borne out by an inspection of the logs), how greatly logs differ in shape from one another.

Like the other operations of the Depot, this operation of classification is dependent on the tides, and as 'time and tide waiteth for no man' this work may have to be carried out at any time between sunrise and sunset. Also, the time-limits within which the work may have to be completed is also short because logs cannot be rolled unless, roughly speaking, the tide rises about the height of the diameter of the log. Also, logs in an arrival report being of various sizes do not all float at the same time. On the average, about 2½ hours' rolling can be done in a day and in this time about 400—500 logs can be rolled and classified, depending on the size and quality (star class) of the logs, the larger number being obtained when the logs are small and when one-star logs predominate.

As, on the average, about twenty seconds and spent on each log, the classification at Nyaungwaing cannot be considered the last word. In order, however, that the Rangoon Lotting staff may not have difficulty in their lotting in the Sale Ponds the logs are gone over whenever opportunity offers and are re-classified as necessary. This is not the final check, however, as the Revenue Assistant inspects all logs during lotting and in the lots before the Sale Catalogue is prepared, and he alters the classification where he considers

this is still necessary subject to the approval of the divisional forest officer.

Stock-Taking.—This work is generally carried out when the stocks are lowest, about June, July, August. In previous years, 1931 to 1937, when each log was measured in addition to having its serial number picked up, the operation took anything from a fortnight to well over a month to complete. Since 1938, this cumbrous system was suspended for the present system of a 'Tally' taken by the divisional forest officer aided by his gazetted Staff. The operation now takes from 3-4 days.

The logs are first separated into small compartments bounded by well-marked booms, each containing on an average about 150 logs or less. They are then counted twice, two different colour-washes being used. If the counts agree the figure is accepted; if they disagree, they are counted again using different colour-washes until two counts agree, or till the mistake of the previous counts are discovered. The 'Tally' party generally consists of nine men, three for each colour, white (lime), black (coaltar) and red (red ochre and earth oil). One man dabs the log with his colour, calling out 'tally' when ten logs are obtained. The recorder then records this as a stroke. The spare man helps to see that every log in the compartment is gone over and also helps to fetch more colour when required. During stock-taking no movement of logs is allowed.

Despatch of logs to Rangoon.—At one time the logs were sent down to Rangoon in rafts under their own power. Now they are towed by the Diesel-engined motor launch "Tectona". The "tow" has to leave Nyaungwaing on an ebb tide in time to be in Rangoon by Low Slack Water, and the time taken is generally about 4 hours. The average number of logs in a "tow" is about 250 logs.

TIMBER PRICE LIST, OCTOBER-NOVEMBER, 1942
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE)

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 40-0-0 per ton.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	
,, ..	,, ..	Madras ..	Logs ..	Rs. 84-9-0 to 93-12-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	
,, ..	,, ..	Madras ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Rs.1-8-0 to 2-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 1-4-0 to 2-4-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
,, ..	,,	Punjab ..	12′×10″×5″ ..	Rs. 13-0-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
,, ..	,, ..	Punjab ..	10′×10″×5″ ..	Rs. 7-10-0 per piece.
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-8-0 per piece.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	Rs. 1-8-0 to 3-0-0 per c.ft.
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 9-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	Rs. 52-9-0 per ton.
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	Rs. 7-0-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 0-12-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Assam ..	Squares ..	Rs. 150-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	
Haldu ..	*Adina Cordifolia* ..	Assam ..	Logs ..	Rs. 100-0-0 per ton.
,, ..	,, ..	Bombay ..	Squares ..	
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 to 1-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 61-7-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-14-0 to 1-0-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-10-0 to 2-0-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers..	
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	
,, ..	,, ..	C. P. ..	Logs ..	Rs.1-4-0 to 1-8-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-10-0 to 0-14-0 per c.ft.
,, ..	..	Madras ..	Logs ..	Rs. 103-2-0 to 197-2-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	Logs ..	
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 90-10-0 per ton.
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	
,, ..	,, ..	C. P. ..	Squares ..	Re. 1-0-0 to 1-8-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel	*Terminalia tomentosa*	Bihar	Logs	Re. 0-14-0 to 1-0-0 per c.ft.
,,	,,	Orissa	Logs	Re. 0-9-0 to 0-12-0 per c.ft.
,,	,,	Madras	Logs	Rs. 65-10-0 per ton.
Mesua	*Mesua ferrea*	Madras	B. G. sleepers	
Mulberry	*Morus alba*	Punjab	Logs	Rs. 4-9-2 per c.ft.
Sal	*Shorea robusta*	Assam	Logs	Rs. 50-0-0 to 125-0-0 per ton.
,,	,,	,,	B. G. sleepers	Rs. 7-4-0 each.
,,	,,	,,	M. G. sleepers	Rs. 2-14-0 each.
,,	,,	Bengal	Logs	
,,	,,	Bihar	Logs	Rs. 1-8-0 to 2-0-0 per c.ft.
,,	,,	,,	B. G. sleepers	Rs. 7-0-0 each (1st class).
,,	,,	,,	M. G. sleepers	Rs. 2-8-0 each (1st class).
,,	,,	C. P.	Logs	Re. 1-0-0 to 1-12-0 per c.ft.
,,	,,	Orissa	Logs	Re. 1-0-0 to 2-0-0 per c.ft.
,,	,,	U. P.	Logs	Rs. 1-8-0 to 1-12-0 per c.ft.
,,	,,	,,	M. G. sleepers	Rs. 2-8-0 to 2-12-0 each.
,,	,,	,,	B. G. sleepers	Rs. 7-0-0 to 7-4-0 each.
Sandalwood	*Santalum album*	Madras	Billets	Rs. 350-0-0 to 895-0-0 per ton.
Sandan	*Ougeinia dalbergioides*	C. P.	Logs	Rs. 2-0-0 per c.ft.
,,	,,	Bihar	Logs	Rs. 1-0-0 to 1-4-0 per c.ft
,,	,,	Orissa	Logs	Re. 0-8-0 to 1-0-0 per c.ft.
Semul	*Bombax malabaricum*	Assam	Logs	Rs. 45-0-0 per ton.
,,	,,	Bihar	Scantlings	Re. 0-9-0 to 0-12-0 per c.ft.
,,	,,	Madras	Logs	
Sissoo	*Dalbergia sissoo*	Punjab	Logs	Rs. 2-7-7 per c.ft.
,,	,,	U. P.	Logs	Rs. 1-8-0 to 1-12-0 per c.ft.
,,	,,	Bengal	Logs	
Sundri	*Heritiera* spp.	Bengal	Logs	
Teak	*Tectona grandis*	Calcutta	Logs 1st class	
,,	,,	,,	Logs 2nd class	
,,	,,	C. P.	Logs	Rs. 1-10-0 to 3-12-0 per c.ft.
,,	,,	,,	Squares	Rs. 1-10-0 to 5-2-10 per c.ft.
,,	,,	Madras	Logs	Rs. 180-7-0 to 234-4-0 per ton.
,,	,,	Bombay	Logs	
,,	,,	,,	M. G. sleepers	

EXTRACTS

GIANT STAR GRASS

BY B. SEN

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Giant Star grass, described by I. B. Pole Evans in *Nature* (1st July 1939), offers unusual possibilities for a solution of two urgent needs of rural India, erosion control and fodder supply. Star grass (*Cynodon plectostachyum*) is an African cousin of our familiar *dub*, but one has to see its performance to believe what it can achieve. This grass was first collected in 1938 by an expedition of the Government of the Union of South Africa in the Great Rift Valley and around Lake Victoria in East Africa. Writing of it in *Nature*, Dr. Pole Evans gave the following particulars:

"Apart from its luscious and dense stand, often three to four feet in height, the most remarkable character of the plant in the veld was its amazing network of robust runners or stolons. Individual plants (during five-and-a-half months) have covered more than 8,000 square feet of soil, and in many instances have put out runners (with offshoots) from the parent plant, measuring in length more than 50 feet. These runners and offshoots, of course, anchor themselves down firmly at almost every node. This material offers great possibilities for erosion control in areas where this grass can be successfully established."

To find out whether Star grass could be established in India, I obtained in 1940 through the courtesy of Dr. Pole Evans a very small quantity of Star grass seeds, less than five grams. Half the quantity was subsequently distributed to different experimental stations in India, for simultaneous trials under different climatic and cultural conditions. In my own laboratory at Almora, Star grass seeds were sown in a box filled with sterilized soil. When the seedlings were five to six inches in height, eight plants were set out in a line at the end of my only available field plot (34 ft. $\times 6\frac{1}{2}$ ft., approximately 1/200 of an acre). Neighbours kindly placed at my disposal two additional strips of land for Star grass trials.

The unusual spread of the grass and its vigorous growth in all three plots at once seemed to justify all the hopes entertained for it. In the course of four months, the eight seedlings in my own plot had spread out and covered the entire area available, and the grass had reached an average height of four feet. The plants could have covered a much larger area if their style of growth had not been seriously cramped by the limitations of the wire fence separating the plot from other experimental beds. A single plant of Star grass, originally planted in May 1940, harvested once in January and again in June 1941, and finally uprooted in October 1941 for photographing, weighed nearly a maund when fresh. The weight of the hay was 25 lb. This is by no means the maximum yield obtainable from the harvest of one plant, for, given the space, each node of the grass will establish itself and eventually become a gigantic plant. A single node of Star grass was planted in a small flower pot (6 inches in diameter) in August 1941, and photographed on 2nd February 1942. The stem of the grass was kept suspended in the air. By February, the length of the main shoot was 16 ft. and the length of the lateral branches totalled 40 feet 4 inches. It must be pointed out, however, that under the unrestricted grazing conditions prevailing in India, which entail serious damage and destruction to grass in the young stages of its growth, the expected yield of fodder would be far below the maximum obtainable under ideal experimental conditions.

As I watched the astonishing growth of Star grass in the different plots at Almora during the summer of 1940, my enthusiasm suddenly received a sharp check. Dr. W. Burns brought to my attention the findings published in a report appearing in the *Agricultural Gazette of New South Wales* to the effect that Star grass is a potential poison grass. New South Wales had also imported and successfully grown seeds of Star grass but the chemists of that country subsequently found that the grass contained the deadly poison, hydrocyanic (Prussic) acid. It is well known that many cultivated plants and grasses contain hydrocyanic acid. Such plants are designated cyanogenetic plants, and they include, among others, millet, sorghum, linseed, flax, Sudan grass, Velvet grass and Arrow grass. At the beginning of my experiments with Star grass, it had

not occurred to me to test it for hydrocyanic acid, because Dr. Pole Evans in his report had stated clearly that not only was this grass found to be the best and most nutritious grass in the African ranching country, but it actually appeared to possess curative properties as well. To quote his words: "It has long been the custom of stock owners who have grazed their animals in the country around Nakuru, where they invariably suffer from 'nukuritis,' to send them to the rich Star grass pasture of Lake Solai, where they immediately pick up in condition and recover." The findings of the Australian chemists, however, necessitated both chemical analyses and actual feeding trials with the Star grass grown in Almora before this grass could be recommended for large scale cultivation in India.

When it was found from a qualitative analysis that the samples of Star grass grown in Almora did contain hydrocyanic acid, my first task was to notify the different departments to whom I had sent seeds of the possible danger and to uproot the young plants from my neighbour's unfenced plot, for it is extremely difficult in this part of the hills to protect grass in the open from the scythes of unbidden Kumaon grass-cutters. The other two patches ultimately survived the attention of the villagers, because of rumours judiciously circulated that the grass was extremely poisonous.

Hydrocyanic acid, which is one of the deadliest of all poisons, acts very quickly. It has been determined that a single dose of pure hydrocyanic acid, weighing only eight grains, administered by mouth, will kill within a few minutes a cow weighing 500 lb. Some of the symptoms of cyanide poisoning are drowsiness, muscular twitching, extreme difficulty of breathing, the inability of the animal to stand. In cyanide poisoning, the processes by which blood supplies oxygen to the tissues necessary for life activity are suspended and the tissues are consequently starved of oxygen, in spite of a sufficiency of it in the blood. Characteristically, the veinous blood remains bright red. If the action of the poison can be stopped before the tissues are killed, normal life can be restored. Chen, Rose and Cloves found that a combination of 22.5 milligrams of sodium nitrite and 2 grams of sodium thiosulphate per kilo (2.2 lb.) bodyweight intravenously injected was a very effective antidote for cyanide poisoning.

It has been experimentally determined by several investigators that the minimum lethal dose, administered by mouth, is in the neighbourhood of 2.315 milligrams per *kilo* bodyweight of the animal. According to this calculation, an animal weighing 500 lb. consuming very rapidly 5 lb. of grass containing as much as 0.02 per cent. of hydrocyanic acid should die, and obviously any such grass should be considered dangerous. For a quantitative analysis of the Star grass, samples were sent in August 1940 to the Imperial Agricultural Chemist, New Delhi, and to the Biochemist, Imperial Veterinary Research Institute, Mukteswar, in the following October. Their reports indicated that the samples were to be considered dangerous, for the August sample was found to contain 0.0196 per cent. of hydrocyanic acid, and the October sample 0.021 per cent. Despite these discouraging reports, further explorations of the practicability of Star grass for fodder were not abandoned, since it is well known that hydrocyanic acid content of a plant varies according to (*i*) the age of the plant, and (*ii*) the climatic and soil conditions of the region where it is grown. Moreover, though on theoretical considerations a grass containing 0.02 per cent. of hydrocyanic acid should be considered dangerous, under actual conditions it may not prove fatal to cattle. Apart from the fact that in Africa Star grass was reported to be an excellent fodder, certain experimental work with digs by Loevenhart, Malone and Martin and with rabbits by Turner and Hulpin showed that these animals, at least, possess a natural capacity to *detoxify*, in the course of an hour, nearly half the minimum fatal dose of hydrocyanic acid. Again, a previous feed of starch concentrate or of any substance which can release sulphur into the blood acts as an antidote to cyanide poisoning. It is only when the poison enters the blood stream at a rate faster than natural detoxification can take place that fatal poisoning occurs. Thus, for example, a cow weighing 500 lb. could automatically detoxify in the course of 24 hours the poison contained in 60 lb. of grass containing 0.02 per cent. of the hydrocyanic acid, and should suffer no ill effects. This assumes that the animal would consume the grass at the even rate of $2\frac{1}{2}$ lb. per hour for 24 hours which, of course, would be an impossible proposition. Therefore, in 1941, two sets of experiments were undertaken: (*a*) actual feeding

trials with Star grass, and (*b*) a series of quantitative estimations of the hydrocyanic acid content of the grass at different stages of its growth.

Feeding trials with Star grass were undertaken in June and July 1941. Of two pairs of rabbits, one pair was kept exclusively on a diet of Star grass for a week, and the other on *dub* grass. At the end of the week, no difference between the two pairs could be observed. The next feeding trials with cattle and sheep, were undertaken with the co-operation of Mr. J. R. Haddow, who sent the experimental animals from the Veterinary Research Institute at Mukteswar. The first animal, a vigorous bull-calf weighing 253 lb., was starved for 18 hours before the feeding experiment with Star grass began. For 48 hours thereafter the calf was given all the freshly cut grass it could eat. During this period it consumed 55 lb. of Star grass. Watch was kept at different odd hours of the day and night for any symptoms of cyanide poisoning, but none could be observed, and with some relief, I was able to return the fatted calf to Mukteswar. Since the capacity of eliminating hydrocyanic acid partly depends on the vigour of the animal, and this particular bull-calf was an unusually fine specimen, a hill bull weighing 247 lb. was next borrowed for a feeding trial, and also a sheep weighing 38 lb. Both were subjected to an exclusive diet of Star grass for 24 hours, and came through without any ill effect.

The only inconclusive feeding experiment was with a locust, captured at Kathgodam railway station in December 1941, when I was on my way down to Delhi. As I happened to have a parcel of fresh Star grass with me, it seemed a golden opportunity to find out whether locusts, which are extremely rapid eaters, could be induced to consume a sufficient quantity of Star grass to suffer fatal consequences, in which case the grass might be cultivated in locust breeding areas for its lethal rather than its nutritious properties. Whether the brute had made up its mind to go on hunger-strike in protest against its captivity inside an inverted glass, or whether it was exercising instinctive discretion, it refused to offer any scientific data, for it did not touch a single blade from the abundant supply of green tops of Star grass placed within its reach inside the glass.

Quantitative estimation of the hydrocyanic acid content of Star grass was simultaneously undertaken together with feeding trials. On 30th June 1941, the samples of the grass used for feeding experiments were found to contain 0.0059 per cent. of hydrocyanic acid. On 31st July, however, samples from the same patch showed a lower percentage, namely 0.0044 per cent., but the second growth (one month old) from plants previously cut for feeding trials showed a higher percentage, 0.0068. The content of hydrocyanic acid in this second growth of grass was subsequently found to decrease progressively from the end of July to January 1942, when the percentage of hydrocyanic acid observed was only 0.0024. (Incidentally, Star grass has been found to withstand the cold much better than the *dub*. It was still green in early January, in Almora, and yellowed only under a heavy snowfall towards the end of January).

A series of separate analyses of the leaves and stalks of Star grass revealed the interesting fact that most of the poison is contained in the leaves: for instance, on 1st July 1941, the leaves contained 0.0152 per cent. and the stalks 0.0016 per cent.; on 29th December 1941, the leaves showed a percentage of 0.0093 and the stalks of only 0.0005, which was of the order found in *dub* grass in July 1941. Therefore, when Star grass is in the early stages of its growth it may be expected to contain the highest percentage of hydrocyanic acid, but the percentage even at this time is well under the theoretical danger limit of 0.02 per cent. With the development of the stalks, the percentage in the sample as a whole diminishes. Whole samples of fresh grass from plants grown in pots in which the development of the leaves was restricted showed in January 1942 only 0.0013 per cent. of hydrocyanic acid. The concentration of poison in the leaves may very likely explain the higher percentage of hydrocyanic acid observed in the samples sent for analysis to New Delhi and Mukteswar in 1940, when only the green tops of the grass were submitted. The sun dried hay of mature Star grass (in which the proportion of the stalk is 50 per cent. or more compared to the leaves) contains an entirely negligible amount of hydrocyanic acid. This is the finding both of the Imperial Agricultural Chemist, New Delhi, in 1940, and of this Laboratory in 1941.

From these results it can be concluded that for controlled pasture Star grass offers immense practical possibilities as a safe

green fodder and hay. As yet I have received no reports of any results obtained from any of the stations in India to which I sent seeds for experiment. A circular letter from the Division of Soil and Veld Conservation of the Union of South Africa, Pretoria, has supplied the interesting information that no authentic records have come to the Department's notice of any stock-poisoning as a result of hydrocyanic acid content in Star grass, either locally or in Kenya or Australia.

Though we know that Star grass is definitely cyanogenetic, so, it may be pointed out, is our harmless cabbage. Analyses undertaken in July 1941 showed that the tender heart-leaves of a cabbage contained hydrocyanic acid of the same order as that found in Star grass, the percentage in cabbage then being 0.0054 and in Star grass 0.0059. Nevertheless, since the average Indian cattle are far from vigorous and are often semi-starved immediately before the rains they might be expected to consume dangerously large quantities of leafy Star grass when the poison content is at its maximum as soon as the rain sets in, if open Star grass pastures were widely established as village grazing grounds. Therefore, until further controlled experiments have been carried out, it is not recommended that Star grass be used as green fodder in India until the grass is at least three months old. A systematic investigation is now in progress to determine the cultural conditions likely to reduce the hydrocyanic acid content of the Star grass. The possibilities of breeding out the poison are also being explored, and four new strains of Star grass are also being investigated. Dr. K. C. Sen of the Izatnagar Nutrition Laboratory is undertaking a complete analysis of the nutritional aspect of Star grass hay.

In the meantime it can be stated that mature Star grass hay holds no risk of poisoning. Even if Star grass were cultivated for hay alone, it would add vastly to the fodder wealth of India. My small field plot (1/200 of an acre) yielded in 1940 one maund of hay, and two and a half maunds from two crops in 1941, apart from a considerable quantity of grass cut for chemical analysis and distribution. On the basis of this calculation an acre would theoretically produce 200 maunds of hay per crop, given a rainfall of 25 to 30 inches a year, and there should be at least two, and possibly three,

crops a year depending on the climatic conditions of the region. Hence Star grass, for its dual uses of erosion control and fodder, may shortly be expected to receive considerable attention throughout India, and to be cultivated on an ever increasing scale, replacing the poorer and less prolific varieties of grazing now available for the underfed cattle population of India.—*Indian Farming*, Vol. III, No. 8, dated August 1942.

FOREST MAXIMS

(1) Fires ruin the land.

(2) Little fires grow to be big ones—kill them when they are young.

(3) Little trees grow to be big ones—protect them when they are young.

(4) Forest fires destroy game, food and drive the animals from the country.

(5) The saplings of to-day will be the saw-logs of to-morrow.

(6) A tree will make a million matches—A match may destroy a million trees—put that match out.

(7) Sowing matches reaping ashes.

(8) Stop fires by not starting them.

(9) Large fires develop from small sparks—look out for that cigarette stub.

(10) Have you any idle land?—Grow trees.

—*Canada's Forests* (a small pamphlet issued by the Department of Mines and Resources, Canada).

MALARIA AND ANTI-MALARIALS

Among the several diseases which afflict this country, malaria occupies the foremost place; it is the largest single-disease endemic in India. Annually 1/3rd of the population of this sub-continent is said to suffer from malaria, and the percentage of deaths among them is appallingly high. Those who survive the attack suffer from its after-effects which often leave a permanent injury on the patient. The loss of economic man-power and human efficiency due to this disease in the British Empire has been estimated at 52 to 62 million pounds a year, more than half of which is shared by this country.

For decades this widespread disease has been allowed to go practically unchecked and no determined and sustained effort commensurate with the magnitude and seriousness of the problem, has been put forward. In this connection, special mention should be made of the Rockfeller Foundation for the valuable services rendered to the Provincial Governments in conducting malarial surveys in the several provinces, and for furnishing the necessary technical personnel.

Methods for combating this disease are well known and they have been widely and successfully adopted in other countries like Italy and Greece. They consist of the destruction of larvae, the draining of swamps, mechanical protection against mosquitoes and prophylaxis by quinine or atebrin and plasmoquine. The problem in this country is complicated by the under-nourished and poverty-stricken condition of its people. The *per capita* consumption of quinine in India as compared with other malaria-stricken countries is only $3\frac{1}{2}$ grains as against the 16 and 24 grains, respectively, in Italy and Greece. The question of malaria control is, therefore, closely connected, firstly, with an adequate supply of prophylactic drugs at prices which the average Indian can afford to pay; secondly, with the speed and efficiency with which the sources of vectors could be minimised if not abolished; and thirdly, with the raising of the standard of nourishment among the masses.

Col. Chopra, in an admirable review of the position of quinine in this country, computes that the maximum potential demand for this drug is 1,500,000 lb. The Public Health Commissioner to the

Government of India is of the opinion that "there is no question of the effective treatment of malaria in India until the consumption of quinine approximates to 500,000 lb." Sir Patrick Hehir has estimated that for India, 970,000 lb. of quinine would be the minimum necessary for a successful tackling of the problem of malaria. At the moment, India's annual production of quinine lies between 60 to 70 thousand pounds, which is supplemented by another 130,000 lb. of imported material. These figures reveal the utter helplessness of the situation and call for the most vigorous effort on the part of those interested in the control of this preventable disease.

The Royal Commission on Agriculture realized the acuteness of this problem and made far-reaching recommendations calculated to make India self-sufficient with regard to this drug. They have pleaded for a rapid expansion of the acreage under cinchona; the evidence presented before the Commission had revealed that for many years the progress of cinchona cultivation in the country, had remained practically stagnant, in spite of the circumstances that large tracts of territory authoritatively pronounced to be suitable for its propagation were found to be available. In view of the imperative urgency and vital importance of this matter, the Royal Commission urged that the Central Government should take up the responsibility of producing and distributing this drug.

In 1928, a committee of representatives of the various provincial governments interested in the propagation of cinchona, was called with a view to elicit their advice regarding the extent and manner in which the recommendations of the Royal Commission could be given effect to. The committee was immediately faced with the financial aspects of the problem and recommended a scheme through which all profit which might accrue would be shared equally by all the consumers. The Malaria Commission of the League of Nations emphasised the importance of quinine as the prophylactic par excellence in the remission of malaria. In spite of all this forceful expression of authoritative opinion and in the face of the brilliant examples of public health administration in other parts of the world nothing substantial or effective has been achieved in controlling the disease in India. Considerations of

philanthropy, humanity and charity and of public health obligatory on all governments, have been overpowered by the modern "shop-keepers instinct". We must here refer to the unostentatious and silent part played by indigenous systems of medicine which have been bringing relief to the millions of the malaria-stricken in rural districts. Captain G. Srinivasamurthy (formerly Principal of the School of Indian Medicine, Madras), who is one of the foremost exponents of Ayurveda, has revealed to us that during the days of the East India Company, a number of indigenous anti-malarials were "auhorized as official substitutes for cinchona and its alkaloids. They were also included in the pharmacopœia of India which was then in use as supplement to the British pharmacopœia." It is regrettable that these specifics have not continued to receive the official recognition with the rise of quinine as the official drug for malaria.

Cinchona was introduced in India and Java at about the same time; its propagation made a considerable headway in this country and at one time it looked as though the country would not only satisfy its requirements but produce a surplus with which a prosperous but not profiteering export trade could be built up. But Java which was backed up by intensive methods of scientific selection and propagation, evolved varieties which yielded richer percentages of the alkaloid. The Dutch are the foremost in the field of plant improvement and have successfully demonstrated their scientific talent and skill with regard to a number of other economic crops like the sugarcane and the tobacco. The valuable experience in these lines, was utilized for the improvement of cinchona which has been responsible for the supremacy of Java in the production of quinine. Overproduction of this drug threatened to reduce the prices to an uneconomic level but the "Kina Bureau", a powerful syndicate, stepped in to control the world price of quinine. Col. Chopra writes in this connection:

"The Kina Bureau has tried and has been successful in effecting regulated and gradual reduction of the cinchona areas to proportions fitted to what the world can afford to buy and not what it really needs. In this way the price has been maintained at a level that leaves a profit both for the plantations and the factories."

"It follows from all this that it would be absolutely futile to expect any large reduction in the price of quinine under the present conditions. So efficient is the control that even the great world-wide depression during recent years has not affected the price of quinine, which still remains at Rs. 18 per pound, which was the price fixed so long ago as 1926."

This monopoly has been challenged by Germany. As a part of their programme of colonial expansion, Germany was keenly interested in the synthesis of specifics for all the tropical diseases like sleeping sickness, yellow fever, malaria, etc. Intensive work on synthetic anti-malarials was launched and in the year 1926, the Elberfeld Chemical Research Laboratory of the I. G. Farbenindustrie, announced the synthesis of plasmo-quine. Four years later Atebrin was synthesised. These two synthetic drugs have now been in use in this country as anti-malarial specifics. Medical opinion in India, while recognising the efficacy of the two drugs, is averse to their general adoption. These drugs have to be administered under careful medical supervision; otherwise they may prove highly toxic. So far as mass treatment of malaria is concerned, quinine still holds the field, since the drug can be safely administered and is even recommended for self-medication. But the price of quinine is too high. "We cannot get away from the fact that quinine is the rich man's remedy, while malaria is the poor man's heritage; but let medicine once admit and practise the value of the other alkaloids and many Indian areas might then be turning out febrifuge at costs more suited to the poor. For, with a change of medical opinion and practice we could make use of kinds of cinchona that do not demand Java soil and climatic conditions for their best development." This extremely helpful suggestion made by the Government Cinchona Department and Factory in Bengal, is supported by Col. Chopra who adds, "It is unfortunate for India that of all the alkaloids of cinchona bark, the merits of quinine alone should have been recognised by the medical profession, with the result that a monopoly has been created for the plantations and factories of Java. A reference to the history of the treatment of malaria in a recently published work by Lieut.-Colonel R. Knowles and Senior-White, shows that this routine use of quinine sulphate

is more or less an accident and that " it is very far from certain that quinine is the best alkaloid of cinchona bark to use. Both quinidine and cinchonidine are most efficacious with regard to their anti-malarial power." The important investigation carried out by Fletcher in Kuala Lampur in the Malay States and the experience at the Calcutta School of Tropical Medicine show that alkaloids of cinchona bark other than quinine are quite effective in the treatment of malaria if given in the usual doses in which quinine is given. The total alkaloids of the bark in the form of cinchona febrifuge have been used in the Carmichael Hospital for Tropical Diseases and at the out-patient department of the school for many years with very satisfactory results." In view of this clinical evidence, it is difficult to resist the demand for using the total alkaloids in place of quinine. This will cheapen the cost of production, facilitate the utilisation of the quinine-poor barks now considered uneconomical for the extraction of quinine and conserve the anti-malarial resources of the country.

The loss of Java has increased the acuteness of the problem a thousandfold. The price of quinine, which was fixed at Rs. 18 by the Kina Bureau has inflated to Rs. 130 per lb. The synthetic anti-malarials have practically vanished from the Indian market. It is high time that the Government realises the importance of taking immediate steps to make the country self-sufficient with regard to this most important drug. In addition to this, it is necessary that the anti-malarial specifics of established reputation in the indigenous systems of medicine, should be investigated with the co-operation of the Pandits and the Hakims. Investigations on the breeding of hardier and richer strains of cinchona should be undertaken and these researches may be appropriately financed by the Imperial Council of Agricultural Research, while researches on synthetic anti-malarials are to a certain extent being financed already by the Board of Scientific and Industrial Research. A Central Advisory Board to co-ordinate and direct these activities should be constituted. This is a matter which demands the earnest attention of the Central Government.

—*Current Science*, Vol. 11, No. 9, dated September, 1942.

CATTLE AVERSE TO GRASS

BY K. CHERIAN JACOB, L.Ag., F.L.S.

In a few villages adjoining the hilly parts of North Arcot and Salem districts in the Madras province, a few ryots maintain a breed of cattle which do not ordinarily eat grass but browse the tender shoots and leaves of *Albizzia amara* Boivin. In November 1940 the writer had occasion to see a herd of this breed of cattle at Kottur, a village near Krishnagiri in the Salem district. The cattle did not seem to take any notice of the rich growth of very good fodder grasses, but were briskly going about to get at the tender shoots and leaves of *Albizzia amara*. The agricultural officers of the place and the villagers informed the writer that these animals do not eat grass but feed only on the leaves of *thurinji* (*Albizzia amara*). Fully aware of the peculiar feeding habits of this breed, herds of them are allowed to pass through footpaths in cultivated fields with apparent immunity to growing crops. They easily cover ten to twelve miles daily in search of their favourite forage in the unreserved forests. It is a hard job for the cowboys to keep pace with them and much more to keep the straying individuals together. Even the milch cows are not fed with any concentrated food. Probably there is no necessity for this food since they feed on young leaves and shoots which are rich in protein.

Characteristics.—The animals are of a wiry build, agile, fleet-footed and of medium size. They have a whitish coat and possess short but pointed horns. The writer was told the story of a herd which chased and gored to death a *cheetah* which lifted a calf from the herd. Since they live usually on the leaves of *thurinji*, this breed of cattle is known as *thurinji thazhai madu, i.e.* cattle which feed on the leaves of *thurinji*. The cows give one to one-and-a-half local measures of milk each time (40 to 60 lb. a day). The milk of this breed is considered to be sweeter and more nutritious than that of the other local types. It has a slightly greenish tinge probably due to the fact that these cows exclusively feed on green *thurinji* leaves.

Apart from the dam's milk, the young calves have to be fed on tender *thurinji* leaves as they too do not eat even the tenderest of grasses. So it is obvious that this quality is inherited.

The colour of the fresh dung is green. The dung and the urine of the cattle have superior manurial value evidently due to their exclusive leguminous feed and the animals are maintained chiefly for that purpose. Herds are penned for the night in the open fields of arable land much in the same manner as sheep penning. The animals are tied by one of their forelegs to wooden pegs driven into the ground.

This enquiry has been confirmed in the main by the District Forest Officer, Salem North, agricultural officers of various places where this breed is found and important ryots owning the cattle in the various tracts who also furnished some more interesting facts about this breed of cattle. Many herds of this breed are found in a number of villages adjoining hilly tracts such as Koraikuppam near Bargur in the Salem district; Gudiyattam, Pernampet, etc. in the North Arcot district.

In some places these cattle are in a semi-wild state and are not put to any farm operations, while in other places they have become very docile and the bulls are used for all sorts of farm operations. They are said to work even better than other cattle when *thurinji* leaves are available in plenty for browsing. On days they are put to work they are let off for browsing by 2 p.m. and they return to the village by 7 p.m. They eat nothing but *thurinji* leaves, but during summer when these trees become defoliated for a short time or when the animals are prevented from walking long distances due to an attack of foot-and-mouth disease, they are compelled to eat anything they are given such as *cholam* (*Sorghum* sp.) stalks, rice straw and grass. They prefer *cholam* stalk to rice straw or grass. The animals have strangely an aptitude for eating bones. In some places, they are actually fed with small pieces of bone once or twice a month. They are reported to be very prolific breeders. In some herds a few coloured animals are found owing to the crossing of these animals with other village cattle.

The animals of this breed are comparatively cheap just because they cannot be maintained in places where *thurinji* plants are not available in plenty. The Forest Department does not allow these cattle to graze in the reserved forests while the other village cattle are allowed to graze by permits. The District Forest Officer desires

that this peculiar breed of cattle may not be encouraged to thrive, as they are detrimental to *thurinji,* a very important tree used for fuel in the majority of the dry deciduous forests in this province.

Albizzia amara is a moderate-sized deciduous tree with low and spreading branches. Leaves are very many bipinnately compound with very small leaflets. The young shoots are clothed with yellowish grey pubescence. The heads of flowers are fragrant with pinkish-white florets. Corolla yellow, nearly three times as long as calyx, pubescent outside. Pods 4 to 7 inches by 3/4 to $1\frac{1}{8}$ inch, stalked, thin, flat, abruptly pointed, slightly transversely veined. Seeds 6 to 8. It is found throughout tropical India in dry forests. The basal portion of this tree is irregularly branched. The branches are so low and spreading that the cowboys easily bend them for the leaves to be browsed by the cattle.

—*Indian Farming,* Vol. III, No. 6, dated June, 1942.